ROBINSON & COLE LLP

KENNETH C. BALDWIN

280 Trumbull Street
Hartford, CT 06103-3597
Main (860) 275-8200
Fax (860) 275-8299
kbaldwin@rc.com
Direct (860) 275-8345

Also admitted in Massachusetts

November 19, 2013

Melanie A. Bachman
Acting Executive Director
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: **Notice of Exempt Modification – Facility Modification**
Greenswood Road East, Norfolk, Connecticut

Dear Ms. Bachman:

Cellco Partnership d/b/a Verizon Wireless ("Cellco") currently maintains twelve (12) antennas at the 160-foot level of the existing 180-foot tower off Greenwoods Road East in Norfolk. The tower is owned by Message Center Management. The Council approved Cellco's use of this tower in 2007. Cellco now intends to replace one (1) of its existing antennas with one (1) model BXA-70063-6CF antenna at the same height on the tower. Included in Attachment 1 is the specification sheet for Cellco's proposed replacement antenna.

Please accept this letter as notification pursuant to R.C.S.A. § 16-50j-73, for construction that constitutes an exempt modification pursuant to R.C.S.A. § 16-50j-72(b)(2). In accordance with R.C.S.A. § 16-50j-73, a copy of this letter is being sent to Susan M. Dyer, First Selectwoman of the Town of Norfolk ("Town"). The Town is the owner of the property where the tower is located.

The planned modifications to the facility fall squarely within those activities explicitly provided for in R.C.S.A. § 16-50j-72(b)(2).

1. The proposed modifications will not result in an increase in the height of the existing tower. Cellco's replacement antenna will be located at the 160-foot level on the 180-foot tower.

2. The proposed modifications will not involve any change to ground-mounted equipment and, therefore, will not require the extension of the site boundary.

3. The proposed modifications will not increase noise levels at the facility by six decibels or more, or to levels that exceed state and local criteria.

4. The operation of the replacement antennas will not increase radio frequency (RF) emissions at the facility to a level at or above the Federal Communications Commission (FCC) safety standard. A cumulative RF emissions calculation for the modified facility is included in Attachment 2.

5. The proposed modifications will not cause a change or alteration in the physical or environmental characteristics of the site.

6. The tower and its foundation can support Cellco's proposed modifications. (*See* Detailed Structural Analysis and Evaluation included in Attachment 3).

For the foregoing reasons, Cellco respectfully submits that the proposed modifications to the above-referenced telecommunications facility constitutes an exempt modification under R.C.S.A. § 16-50j-72(b)(2).

Sincerely,

Kenneth C. Baldwin

Enclosures
Copy to:
Susan M. Dyer, Norfolk First Selectwoman
Sandy M. Carter

ATTACHMENT 1

BXA-70063-6CF-EDIN-X

X-Pol | FET Panel | 63° | 14.5 dBd

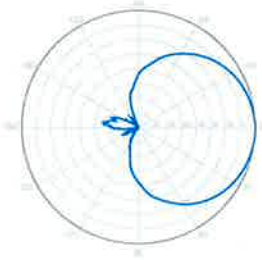
Replace "X" with desired electrical downtilt.

Antenna is also available with NE connector(s). Replace "EDIN" with "NE" in the model number when ordering.

Electrical Characteristics	696-900 MHz	
Frequency bands	696-806 MHz	806-900 MHz
Polarization	±45°	
Horizontal beamwidth	65°	63°
Vertical beamwidth	13°	11°
Gain	14.0 dBd (16.1 dBi)	14.5 dBd (16.6 dBi)
Electrical downtilt (X)	0, 2, 3, 4, 5, 6, 8, 10	
Impedance	50Ω	
VSWR	≤1.35:1	
Upper sidelobe suppression (0°)	-18.3 dB	-18.2 dB
Front-to-back ratio (+/-30°)	-33.4 dB	-36.3 dB
Null fill	5% (-26.02 dB)	
Isolation between ports	< -25 dB	
Input power with EDIN connectors	500 W	
Input power with NE connectors	300 W	
IM3 (2x20W carriers)	< -153 dBc	
Lightning protection	Direct Ground	
Connector(s)	2 Ports / EDIN or NE / Female / Center (Back)	
Mechanical Characteristics		
Dimensions Length x Width x Depth	1804 x 285 x 132 mm	71.0 x 11.2 x 5.2 in
Depth with z-brackets	172 mm	6.8 in
Weight without mounting brackets	7.9 kg	17 lbs
Survival wind speed	> 201 km/hr	> 125 mph
Wind area	Front: 0.51 m^2 Side: 0.24 m^2	Front: 5.5 ft^2 Side: 2.6 ft^2
Wind load @ 161 km/hr (100 mph)	Front: 759 N Side: 391 N	Front: 169 lbf Side: 89 lbf

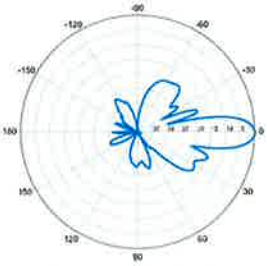
Mounting Options	Part Number	Fits Pipe Diameter	Weight
3-Point Mounting & Downtilt Bracket Kit	36210008	40-115 mm 1.57-4.5 in	6.9 kg 15.2 lbs
Concealment Configurations	For concealment configurations, order BXA-70063-6CF-EDIN-X-FP		

BXA-70063-6CF-EDIN-X



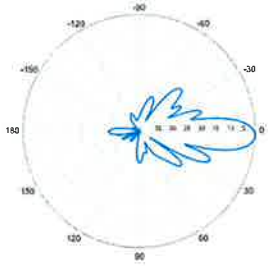
Horizontal | 750 MHz

BXA-70063-6CF-EDIN-0

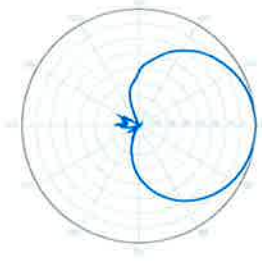


0° | Vertical | 750 MHz

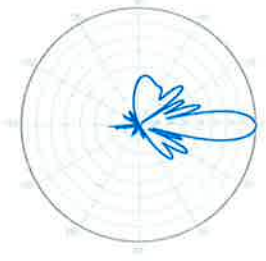
BXA-70063-6CF-EDIN-2



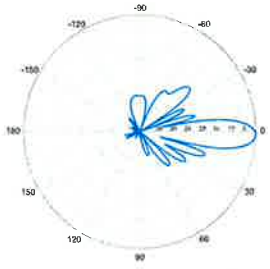
2° | Vertical | 750 MHz



Horizontal | 850 MHz



0° | Vertical | 850 MHz



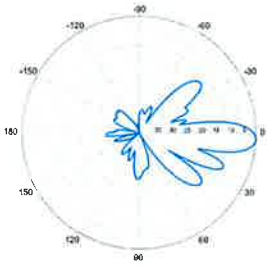
2° | Vertical | 850 MHz

Quoted performance parameters are provided to offer typical or range values only and may vary as a result of normal manufacturing and operational conditions. Extreme operational conditions and/or stress on structural supports is beyond our control. Such conditions may result in damage to this product. Improvements to product may be made without notice.

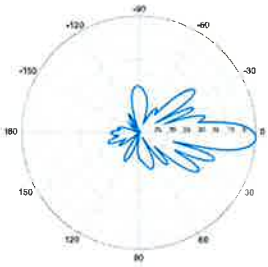
BXA-70063-6CF-EDIN-X

X-Pol | FET Panel | 63° | 14.5 dBd

BXA-70063-6CF-EDIN-3

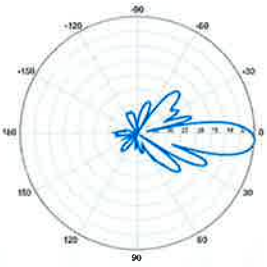


3° | Vertical | 750 MHz

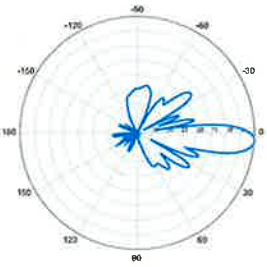


3° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-4

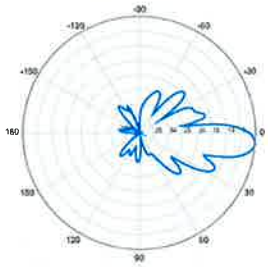


4° | Vertical | 750 MHz

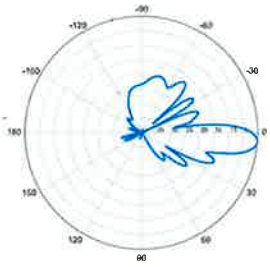


4° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-5

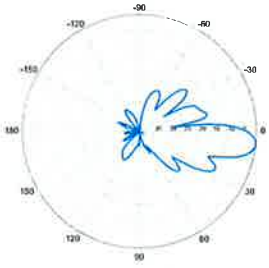


5° | Vertical | 750 MHz

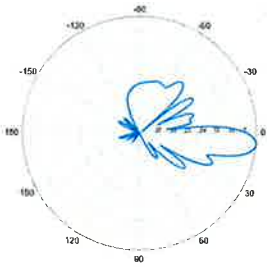


5° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-6

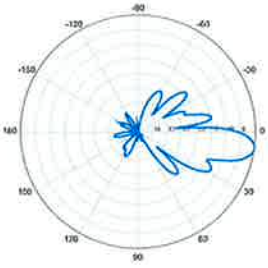


6° | Vertical | 750 MHz

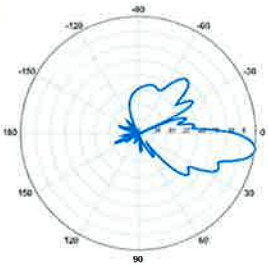


6° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-8

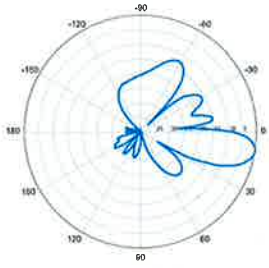


8° | Vertical | 750 MHz

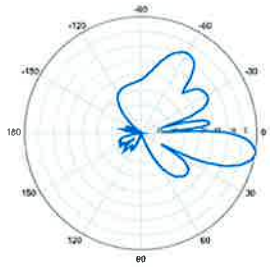


8° | Vertical | 850 MHz

BXA-70063-6CF-EDIN-10



10° | Vertical | 750 MHz



10° | Vertical | 850 MHz

	General	Power	Density					
Site Name: Norfolk E								
Tower Height: Verizon @ 160ft								
CARRIER	**# OF CHAN.**	**WATTS ERP**	**HEIGHT**	**CALC. POWER DENS**	**FREQ.**	**MAX. PERMISS. EXP.**	**FRACTION MPE**	**Total**
*Cingular	6	296	180	0.0197	880	0.5867	3.36%	
*Cingular	3	427	180	0.0142	1930	1.0000	1.42%	
Verizon PCS	**7**	**317**	**160**	**0.0312**	**1970**	**1.0000**	**3.12%**	
Verizon Cellular	**9**	**339**	**160**	**0.0429**	**869**	**0.5793**	**7.40%**	
Verizon AWS	**1**	**1750**	**160**	**0.0246**	**2145**	**1.0000**	**2.46%**	
Verizon 700	**1**	**793**	**160**	**0.0111**	**698**	**0.4653**	**2.39%**	
								20.15%
* Source: Siting Council								

ATTACHMENT 3

DETAILED STRUCTURAL ANALYSIS AND EVALUATION OF AN EXISTING 180' MONOPOLE FOR PROPOSED ANTENNA ARRANGEMENT

Site Name: Norfolk East CT
Address: Greenwoods Road East (Route 44)
Norfolk, Connecticut

prepared for

Verizon Wireless
99 East River Drive
East Hartford, Connecticut 06108

prepared by

URS CORPORATION
500 ENTERPRISE DRIVE, SUITE 3B
ROCKY HILL, CT 06067
TEL. 860-529-8882

36917416.00000
VZ5-167

October 16, 2013

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report summarizes the structural analysis of the existing 180' steel tapered monopole structure, located at Greenwoods Road East (Route 44) in Norfolk, Connecticut. The analysis was conducted in accordance with the 2005 Connecticut State Building Code and the TIA/EIA-222-F standard for a wind velocity of 80 mph (fastest mile) and 69 mph (fastest mile) concurrent with ½" ice. The antenna loading considered in the analysis consists of all existing and proposed antennas, transmission lines, and ancillary items as outlined in the Introduction Section of this report. The proposed Verizon Wireless installation is as follows:

Proposed Antenna and Mount	Carrier	Antenna Center Elevation
Remove: (1) RFS APX75-868011-CT0	Verizon (Existing)	@ 160'
Install: (1) Antel BXA-70063-6CF-2	Verizon (Proposed)	@ 160'

The results of the analysis indicate that the tower structure has the capacity to support the proposed loading conditions. **The tower, base plate, anchor bolts, and its foundation are considered structurally adequate with the wind load classification specified above and the proposed antenna loading.**

This analysis is based on:

1) The tower structure's theoretical capacity, not including any assessment of the condition of the tower.
2) Previous structural analysis performed by URS on behalf of Verizon Wireless, project number VZ5-107 / 36922265, signed and sealed January 31, 2012.
3) Tower and foundation design documents prepared by Valmont Communications (Order #11004-67), signed and sealed July 19, 2007.
4) Geotechnical report prepared by Dr. Clarence Welti, P.E., P.C., dated March 4, 2007.
5) Antenna and mount configuration as specified within Section 2 and 6 of this report.

This report is only valid as per the assumptions and data utilized in this report for antenna inventory, mounts and associated cables. The user of this report shall field verify the assumption of the antenna and mount configuration as well as the physical condition of the tower. Notify the engineer in writing immediately if any of the information in this report is found to be other than specified.

If you should have any questions, please call.

Sincerely,

URS Corporation

Richard A. Sambor, P.E.
Senior Structural Engineer

RAS/car

2. INTRODUCTION

The subject tower is located at Greenwoods Road East (Route 44) in Norfolk, Connecticut. The structure is an existing 180' steel tapered monopole structure, designed by Valmont Communications (Order #11004-67), signed and sealed July 19, 2007.

The inventory is summarized in the table below:

Antenna Type	*Carrier*	*Mount*	*Antenna Centerline Elevation*	*Cable*
(12) Powerwave 7770 (12) TMAs	AT&T (reserved)	Low Profile Platform	180'	(12) 1-5/8"
(6) Amphenol LPA-80080-6CF-EDIN-0 (6) TMAs (2) Amphenol BXA-70080-6CF-EDIN (1 per Beta & Gamma Sectors) (3) Amphenol BXA-171085-12BF-EDIN (6) Diplexers	Verizon (existing)	Low Profile Platform	160'	(12) 1-5/8"
(1) Antel BXA-70063-6CF-2 (Alpha Sector)	**Verizon (proposed)**	***Shared with Above***	**160'**	***Shared with Above***

This structural analysis of the communications tower was performed by URS Corporation (URS) for Verizon Wireless. The purpose of this analysis was to investigate the structural integrity of the existing tower with its existing and proposed antenna loads. This analysis was conducted to evaluate stress on the tower and the effect of forces to the foundation of the tower resulting from existing and proposed antenna arrangements.

3. ANALYSIS METHODOLOGY AND LOADING CONDITIONS

The structural analysis was conducted in accordance with the 2005 Connecticut State Building Code, TIA/EIA-222-F - Structural Standard for Steel Antenna Towers and Antenna Supporting Structures, and the American Institute of Steel Construction (AISC) Manual of Steel Construction - Allowable Stress Design (ASD).

The analysis was conducted using tnx Tower 6.0. Two load conditions were evaluated as shown below which were compared to allowable stresses according to AISC and TIA/EIA.

Load Condition 1 = 80 mph (fastest mile) Wind Load (without ice) + Tower Dead Load
Load Condition 2 = 69 mph (fastest mile) Wind Load (with ice) + Ice Load + Tower Dead Load

Please note that wind pressure is a function of velocity squared. Under Load Condition 2, a 25 percent reduction in wind pressure is allowed by code to account for the unlikelihood of the full wind pressure and ice load occurring at the same time. The same results may be achieved by utilizing a lower wind pressure without taking the 25 percent reduction, as shown above.

The TIA/EIA standard permits a one-third increase in allowable stresses for towers and monopoles less than 700 feet tall. For the purposes of this analysis, in computing the load capacity the allowable stresses of the tower members were increased by one-third.

4. FINDINGS AND EVALUATION

Combined axial and bending stresses on the monopole structure were evaluated to compare with allowable stresses in accordance with AISC. The calculated stresses under the proposed loading were below the allowable stresses (see table below). Detailed analysis and calculations for the proposed load condition are provided in section 6 of this report. Additionally, the anchor bolts, base plate and foundation were found to be within the allowable limits.

Tower Component Stress vs. Capacity Summary

Component (Section No.)	Controlling Component / Elevation	Stress Ratio (% capacity)	Pass/Fail	Notes:
Pole Shaft (L3)	TP48.88x41.4744x0.375 / 45.5'-91.9'	61.3%	**Pass**	
Anchor Bolts	Compression	56%	**Pass**	
Base Plate	Bending	30%	**Pass**	

Foundation Summary

Foundation	Component	Stress (% capacity / FOS)	Pass/Fail	Comments:
Reinforced Concrete Pad	Overturning	56.2% / 3.56	**Pass**	Min. F.O.S of 2.0 req'd per IBC 2003 Section 3108.4.2

5. CONCLUSIONS AND RECOMMENDATIONS

The results of the analysis indicate that the tower structure has the capacity to support the proposed loading conditions. **The tower, base plate, anchor bolts, and its foundation are considered structurally adequate with the wind load classification specified above and the proposed antenna loading.**

Limitations/Assumptions:

This report is based on the following:

1. Tower inventory as listed in this report.
2. Tower is properly installed and maintained.
3. All members are as specified in the original design documents and are in good condition.
4. All required members are in place.
5. All bolts are in place and are properly tightened.
6. Tower is in plumb condition.
7. All member protective coatings are in good condition.
8. All tower members were properly designed, detailed, fabricated, and installed and have been properly maintained since erection.
9. Foundations were properly constructed to support original design loads as specified in the original design documents.
10. All coaxial cable is installed within the monopole unless specified otherwise.

URS is not responsible for any modifications completed prior to or hereafter in which URS is not or was not directly involved. Modifications include but are not limited to:

A. Adding antennas
B. Removing/replacing antennas
C. Adding coaxial cables

URS hereby states that this document represents the entire report and that it assumes no liability for any factual changes that may occur after the date of this report. All representations, recommendations, and conclusions are based upon information contained and set forth herein. If you are aware of any information which conflicts with that which is contained herein, or you are aware of any defects arising from original design, material, fabrication, or erection deficiencies, you should disregard this report and immediately contact URS. URS disclaims all liability for any representation, recommendation, or conclusion not expressly stated herein.

Ongoing and Periodic Inspection and Maintenance:

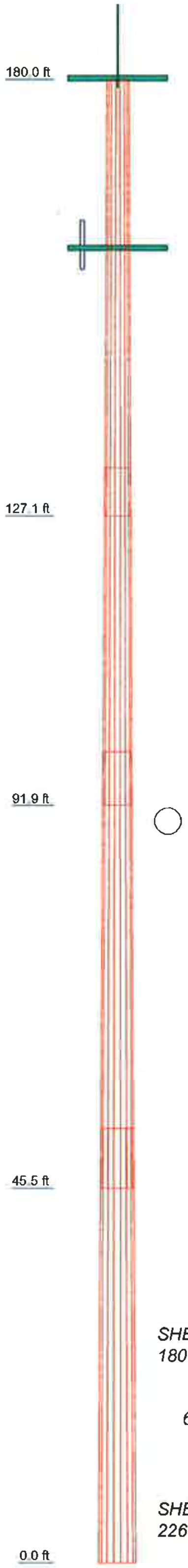
After the Contractor has successfully completed the installation and the work has been accepted, the owner will be responsible for the ongoing and periodic inspection and maintenance of the tower.

The owner shall refer to TIA/EIA-222-F for recommendations for maintenance and inspection. The frequency of the inspection and maintenance intervals is to be determined by the owner based upon actual site and environmental conditions. It is recommended that a complete and thorough inspection of the entire tower structural system be performed at least yearly and more frequently as conditions warrant. According to TIA/EIA-222-F section 14.1, Note 1: It is recommended that the structure be inspected after severe wind and/or ice storms or other extreme loading conditions.

6. DRAWINGS AND DATA

TNX TOWER INPUT/OUTPUT SUMMARY

Section	1	2	3	4	
Length (ft)	52.91	41.02	52.90	52.75	
Number of Sides	18	18	18	18	
Thickness (in)	0.2188	0.2813	0.3750	0.5000	
Socket Length (ft)	5.83	6.50	7.25		
Top Dia (in)	31.0500	37.2038	41.4744	47.1151	
Bot Dia (in)	38.4580	42.9470	48.8800	54.5000	
Grade	A572-65				
Weight (lb)	4317.3	4958.5	9599.1	14330.8	33205.7



AXIAL
48093 lb

SHEAR
18069 lb

MOMENT
2258 kip-ft

TORQUE 0 kip-ft
69 mph WIND - 0.5000 in ICE

AXIAL
41250 lb

SHEAR
22697 lb

MOMENT
2766 kip-ft

TORQUE 0 kip-ft
REACTIONS - 80 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Lightning Rod 2"x8'	184	BXA-70080-6CF-EDIN (Verizon)	160
PiROD 13' Low Profile Platform (Monopole) (Carrier)	180.5	BXA-70080-6CF-EDIN (Verizon)	160
		BXA-171085-12BF-EDIN (Verizon)	160
(4) 7770 (ATI)	180	(2) TMA (Verizon)	160
(4) TMA (ATI)	180	BXA-171085-12BF-EDIN (Verizon)	160
(4) 7770 (ATI)	180	(2) TMA (Verizon)	160
(4) TMA (ATI)	180	BXA-171085-12BF-EDIN (Verizon)	160
(4) 7770 (ATI)	180	(2) TMA (Verizon)	160
(4) TMA (ATI)	180	PiROD 13' Low Profile Platform (Monopole) (Carrier)	160
LPA-80080-6CF-EDIN (Verizon)	160		
Diplexer (Verizon)	160	LPA-80080-6CF-EDIN (Verizon)	160
Diplexer (Verizon)	160	LPA-80080-6CF-EDIN (Verizon)	160
LPA-80080-6CF-EDIN (Verizon)	160	Diplexer (Verizon)	160
LPA-80080-6CF-EDIN (Verizon)	160	Diplexer (Verizon)	160
Diplexer (Verizon)	160	LPA-80080-6CF-EDIN (Verizon)	160
Diplexer (Verizon)	160	BXA-70063-6CF-EDIN-2 (Verizon)	160

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-65	65 ksi	80 ksi			

TOWER DESIGN NOTES

1. Tower is located in Litchfield County, Connecticut.
2. Tower designed for a 80 mph basic wind in accordance with the TIA/EIA-222-F Standard.
3. Tower is also designed for a 69 mph basic wind with 0.50 in ice.
4. Deflections are based upon a 50 mph wind.
5. TOWER RATING: 61.3%

URS Corporation	Job: ***Valmont 180' Monopole***		
500 Enterprise Drive, Suite 3B	Project: ***Greenwood Road East, Norfolk, CT***		
Rocky Hill, CT	Client: Verizon	Drawn by: Christopher Russo	App'd:
Phone: (860) 529-8882	Code: TIA/EIA-222-F	Date: 10/15/13	Scale: NTS
FAX: (860) 529-3991	Path:		Dwg No. E-1

TNX TOWER DETAILED OUTPUT

tnxTower	Job	Page
	Valmont 180' Monopole	1 of 20
URS Corporation 500 Enterprise Drive, Suite 3B Rocky Hill, CT Phone: (860) 529-8882 FAX: (860) 529-3991	**Project** Greenwood Road East, Norfolk, CT	**Date** 15:12:59 10/15/13
	Client Verizon	**Designed by** Christopher Russo

Tower Input Data

There is a pole section.
This tower is designed using the TIA/EIA-222-F standard.
The following design criteria apply:

- Tower is located in Litchfield County, Connecticut.
- Basic wind speed of 80 mph.
- Nominal ice thickness of 0.5000 in.
- Ice density of 56 pcf.
- A wind speed of 69 mph is used in combination with ice.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 50 mph.
- A non-linear (P-delta) analysis was used.
- Pressures are calculated at each section.
- Stress ratio used in pole design is 1.333.
- Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.

Options

	Consider Moments - Legs		Distribute Leg Loads As Uniform		Treat Feedline Bundles As Cylinder
	Consider Moments - Horizontals		Assume Legs Pinned		Use ASCE 10 X-Brace Ly Rules
	Consider Moments - Diagonals	√	Assume Rigid Index Plate		Calculate Redundant Bracing Forces
	Use Moment Magnification		Use Clear Spans For Wind Area		Ignore Redundant Members in FEA
√	Use Code Stress Ratios		Use Clear Spans For KL/r		SR Leg Bolts Resist Compression
√	Use Code Safety Factors - Guys		Retension Guys To Initial Tension		All Leg Panels Have Same Allowable
	Escalate Ice		Bypass Mast Stability Checks		Offset Girt At Foundation
	Always Use Max Kz		Use Azimuth Dish Coefficients	√	Consider Feedline Torque
	Use Special Wind Profile	√	Project Wind Area of Appurt.		Include Angle Block Shear Check
	Include Bolts In Member Capacity		Autocalc Torque Arm Areas		Poles
	Leg Bolts Are At Top Of Section		SR Members Have Cut Ends	√	Include Shear-Torsion Interaction
	Secondary Horizontal Braces Leg	√	Sort Capacity Reports By Component		Always Use Sub-Critical Flow
	Use Diamond Inner Bracing (4 Sided)		Triangulate Diamond Inner Bracing		Use Top Mounted Sockets
	Add IBC .6D+W Combination				

Tapered Pole Section Geometry

Section	*Elevation*	*Section Length*	*Splice Length*	*Number of Sides*	*Top Diameter*	*Bottom Diameter*	*Wall Thickness*	*Bend Radius*	*Pole Grade*
	ft	*ft*	*ft*		*in*	*in*	*in*	*in*	
L1	180.00-127.09	52.91	5.83	18	31.0500	38.4580	0.2188	0.8750	A572-65 (65 ksi)
L2	127.09-91.90	41.02	6.50	18	37.2038	42.9470	0.2813	1.1250	A572-65 (65 ksi)
L3	91.90-45.50	52.90	7.25	18	41.4744	48.8800	0.3750	1.5000	A572-65 (65 ksi)
L4	45.50-0.00	52.75		18	47.1151	54.5000	0.5000	2.0000	A572-65 (65 ksi)

Tapered Pole Properties

Section	Tip Dia. in	Area in^2	I in^4	r in	C in	I/C in^3	J in^4	It/Q in^2	w in	w/t
L1	31.5290	21.4065	2570.7854	10.9451	15.7734	162.9823	5144.9536	10.7053	5.0798	23.222
	39.0513	26.5500	4904.7913	13.5749	19.5367	251.0557	9816.0364	13.2775	6.3836	29.182
L2	38.6071	32.9603	5676.9177	13.1075	18.8995	300.3733	11361.3053	16.4833	6.0529	21.521
	43.6095	38.0872	8759.4141	15.1463	21.8171	401.4935	17530.3540	19.0472	7.0637	25.115
L3	43.0382	48.9186	10439.5871	14.5903	21.0690	495.4948	20892.9109	24.4640	6.6395	17.705
	49.6341	57.7331	17160.7066	17.2193	24.8310	691.0990	34343.9938	28.8720	7.9429	21.181
L4	48.8725	73.9781	20309.2142	16.5483	23.9345	848.5348	40645.1517	36.9961	7.4123	14.825
	55.3408	85.6980	31571.5320	19.1700	27.6860	1140.3428	63184.6066	42.8571	8.7120	17.424

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in
L1 180.00-127.09				1	1	1		
L2 127.09-91.90				1	1	1		
L3 91.90-45.50				1	1	1		
L4 45.50-0.00				1	1	1		

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight plf
1 5/8	A	No	Inside Pole	180.00 - 0.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04
1 5/8	A	No	Inside Pole	160.00 - 0.00	12	No Ice	0.00	1.04
						1/2" Ice	0.00	1.04

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight lb
L1	180.00-127.09	A	0.000	0.000	0.000	0.000	1071.108
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.000
L2	127.09-91.90	A	0.000	0.000	0.000	0.000	878.260
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.000
L3	91.90-45.50	A	0.000	0.000	0.000	0.000	1158.144
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.000
L4	45.50-0.00	A	0.000	0.000	0.000	0.000	1135.687
		B	0.000	0.000	0.000	0.000	0.000
		C	0.000	0.000	0.000	0.000	0.000

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight lb
L1	180.00-127.09	A	0.500	0.000	0.000	0.000	0.000	1071.108
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.000
L2	127.09-91.90	A	0.500	0.000	0.000	0.000	0.000	878.260
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.000
L3	91.90-45.50	A	0.500	0.000	0.000	0.000	0.000	1158.144
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.000
L4	45.50-0.00	A	0.500	0.000	0.000	0.000	0.000	1135.687
		B		0.000	0.000	0.000	0.000	0.000
		C		0.000	0.000	0.000	0.000	0.000

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
L1	180.00-127.09	0.0000	0.0000	0.0000	0.0000
L2	127.09-91.90	0.0000	0.0000	0.0000	0.0000
L3	91.90-45.50	0.0000	0.0000	0.0000	0.0000
L4	45.50-0.00	0.0000	0.0000	0.0000	0.0000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
Lightning Rod 2"x8'	C	None		0.0000	184.00	No Ice	2.00	2.00	80.000
						1/2" Ice	3.02	3.02	95.501
PiROD 13' Low Profile Platform (Monopole) (Carrier)	A	None		0.0000	180.50	No Ice	15.70	15.70	1300.000
						1/2" Ice	20.10	20.10	1765.000
PiROD 13' Low Profile Platform (Monopole) (Carrier)	A	None		0.0000	160.00	No Ice	15.70	15.70	1300.000
						1/2" Ice	20.10	20.10	1765.000
LPA-80080-6CF-EDIN (Verizon)	A	From Face	3.50 6.00 0.00	0.0000	160.00	No Ice	4.32	9.10	21.000
						1/2" Ice	4.76	9.65	69.256
LPA-80080-6CF-EDIN (Verizon)	A	From Face	3.50 -6.00 0.00	0.0000	160.00	No Ice	4.32	9.10	21.000
						1/2" Ice	4.76	9.65	69.256
Diplexer (Verizon)	A	From Face	3.50 6.00	0.0000	160.00	No Ice	0.52	0.14	15.000
						1/2" Ice	0.62	0.20	18.242

Description	Face or Leg	Offset Type	Offsets: Horz Lateral / Vert ft / ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
			0.00						
Diplexer	A	From Face	3.50	0.0000	160.00	No Ice	0.52	0.14	15.000
(Verizon)			-6.00			1/2" Ice	0.62	0.20	18.242
			0.00						
LPA-80080-6CF-EDIN	B	From Face	3.50	0.0000	160.00	No Ice	4.32	9.10	21.000
(Verizon)			6.00			1/2" Ice	4.76	9.65	69.256
			0.00						
LPA-80080-6CF-EDIN	B	From Face	3.50	0.0000	160.00	No Ice	4.32	9.10	21.000
(Verizon)			-6.00			1/2" Ice	4.76	9.65	69.256
			0.00						
Diplexer	B	From Face	3.50	0.0000	160.00	No Ice	0.52	0.14	15.000
(Verizon)			6.00			1/2" Ice	0.62	0.20	18.242
			0.00						
Diplexer	B	From Face	3.50	0.0000	160.00	No Ice	0.52	0.14	15.000
(Verizon)			-6.00			1/2" Ice	0.62	0.20	18.242
			0.00						
LPA-80080-6CF-EDIN	C	From Face	3.50	0.0000	160.00	No Ice	4.32	9.10	21.000
(Verizon)			6.00			1/2" Ice	4.76	9.65	69.256
			0.00						
LPA-80080-6CF-EDIN	C	From Face	3.50	0.0000	160.00	No Ice	4.32	9.10	21.000
(Verizon)			-6.00			1/2" Ice	4.76	9.65	69.256
			0.00						
Diplexer	C	From Face	3.50	0.0000	160.00	No Ice	0.52	0.14	15.000
(Verizon)			6.00			1/2" Ice	0.62	0.20	18.242
			0.00						
Diplexer	C	From Face	3.50	0.0000	160.00	No Ice	0.52	0.14	15.000
(Verizon)			-6.00			1/2" Ice	0.62	0.20	18.242
			0.00						
BXA-70080-6CF-EDIN	B	From Face	3.50	0.0000	160.00	No Ice	5.77	4.56	18.000
(Verizon)			0.00			1/2" Ice	6.22	5.00	54.296
			0.00						
BXA-70080-6CF-EDIN	C	From Face	3.50	0.0000	160.00	No Ice	5.77	4.56	18.000
(Verizon)			0.00			1/2" Ice	6.22	5.00	54.296
			0.00						
BXA-171085-12BF-EDIN	A	From Face	3.50	0.0000	160.00	No Ice	4.73	3.57	15.000
(Verizon)			4.00			1/2" Ice	5.18	4.01	42.198
			0.00						
(2) TMA	A	From Face	3.50	0.0000	160.00	No Ice	2.18	0.37	18.000
(Verizon)			4.00			1/2" Ice	2.38	0.49	28.150
			0.00						
BXA-171085-12BF-EDIN	B	From Face	3.50	0.0000	160.00	No Ice	4.73	3.57	15.000
(Verizon)			4.00			1/2" Ice	5.18	4.01	42.198
			0.00						
(2) TMA	B	From Face	3.50	0.0000	160.00	No Ice	2.18	0.37	18.000
(Verizon)			4.00			1/2" Ice	2.38	0.49	28.150
			0.00						
BXA-171085-12BF-EDIN	C	From Face	3.50	0.0000	160.00	No Ice	4.73	3.57	15.000
(Verizon)			4.00			1/2" Ice	5.18	4.01	42.198
			0.00						
(2) TMA	C	From Face	3.50	0.0000	160.00	No Ice	2.18	0.37	18.000
(Verizon)			4.00			1/2" Ice	2.38	0.49	28.150
			0.00						
(4) 7770	A	From Face	3.50	0.0000	180.00	No Ice	5.88	2.93	39.000
(AT&T)			0.00			1/2" Ice	6.31	3.27	71.634
			0.00						
(4) TMA	A	From Face	3.50	0.0000	180.00	No Ice	2.18	0.37	18.000
(AT&T)			0.00			1/2" Ice	2.38	0.49	28.150

Description	Face or Leg	Offset Type	Offsets: Horz Lateral / Vert	Azimuth Adjustment	Placement		C_AA_A Front	C_AA_A Side	Weight
			ft / ft / ft	°	ft		ft^2	ft^2	lb
			0.00						
(4) 7770	B	From Face	3.50	0.0000	180.00	No Ice	5.88	2.93	39.000
(AT&T)			0.00			1/2" Ice	6.31	3.27	71.634
			0.00						
(4) TMA	B	From Face	3.50	0.0000	180.00	No Ice	2.18	0.37	18.000
(AT&T)			0.00			1/2" Ice	2.38	0.49	28.150
			0.00						
(4) 7770	C	From Face	3.50	0.0000	180.00	No Ice	5.88	2.93	39.000
(AT&T)			0.00			1/2" Ice	6.31	3.27	71.634
			0.00						
(4) TMA	C	From Face	3.50	0.0000	180.00	No Ice	2.18	0.37	18.000
(AT&T)			0.00			1/2" Ice	2.38	0.49	28.150
			0.00						
BXA-70063-6CF-EDIN-2	A	From Face	3.50	0.0000	160.00	No Ice	7.73	4.16	32.200
(Verizon)			0.00			1/2" Ice	8.27	4.60	74.687
			0.00						

Tower Pressures - No Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1	152.93	1.55	25	153.245	A	0.000	153.245	153.245	100.00	0.000	0.000
180.00-127.09					B	0.000	153.245		100.00	0.000	0.000
					C	0.000	153.245		100.00	0.000	0.000
L2	109.34	1.408	23	118.708	A	0.000	118.708	118.708	100.00	0.000	0.000
127.09-91.90					B	0.000	118.708		100.00	0.000	0.000
					C	0.000	118.708		100.00	0.000	0.000
L3 91.90-45.50	68.72	1.233	20	176.444	A	0.000	176.444	176.444	100.00	0.000	0.000
					B	0.000	176.444		100.00	0.000	0.000
					C	0.000	176.444		100.00	0.000	0.000
L4 45.50-0.00	22.33	1	16	194.571	A	0.000	194.571	194.571	100.00	0.000	0.000
					B	0.000	194.571		100.00	0.000	0.000
					C	0.000	194.571		100.00	0.000	0.000

Tower Pressure - With Ice

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1	152.93	1.55	19	0.5000	157.654	A	0.000	157.654	157.654	100.00	0.000	0.000

Section Elevation ft	z ft	K_Z	q_z psf	t_Z in	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
180.00-127.09						B	0.000	157.654		100.00	0.000	0.000
						C	0.000	157.654		100.00	0.000	0.000
L2 127.09-91.90	109.34	1.408	17	0.5000	121.640	A	0.000	121.640	121.640	100.00	0.000	0.000
						B	0.000	121.640		100.00	0.000	0.000
						C	0.000	121.640		100.00	0.000	0.000
L3 91.90-45.50	68.72	1.233	15	0.5000	180.311	A	0.000	180.311	180.311	100.00	0.000	0.000
						B	0.000	180.311		100.00	0.000	0.000
						C	0.000	180.311		100.00	0.000	0.000
L4 45.50-0.00	22.33	1	12	0.5000	198.362	A	0.000	198.362	198.362	100.00	0.000	0.000
						B	0.000	198.362		100.00	0.000	0.000
						C	0.000	198.362		100.00	0.000	0.000

Tower Pressure - Service

$G_H = 1.690$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	152.93	1.55	10	153.245	A	0.000	153.245	153.245	100.00	0.000	0.000
180.00-127.09					B	0.000	153.245		100.00	0.000	0.000
					C	0.000	153.245		100.00	0.000	0.000
L2	109.34	1.408	9	118.708	A	0.000	118.708	118.708	100.00	0.000	0.000
127.09-91.90					B	0.000	118.708		100.00	0.000	0.000
					C	0.000	118.708		100.00	0.000	0.000
L3 91.90-45.50	68.72	1.233	8	176.444	A	0.000	176.444	176.444	100.00	0.000	0.000
					B	0.000	176.444		100.00	0.000	0.000
					C	0.000	176.444		100.00	0.000	0.000
L4 45.50-0.00	22.33	1	6	194.571	A	0.000	194.571	194.571	100.00	0.000	0.000
					B	0.000	194.571		100.00	0.000	0.000
					C	0.000	194.571		100.00	0.000	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	1071.108	4317.331	A	1	0.65	1	1	1	153.245	4268.642	80.67	C
180.00-127.09			B	1	0.65	1	1	1	153.245			
			C	1	0.65	1	1	1	153.245			
L2	878.260	4958.495	A	1	0.65	1	1	1	118.708	3004.880	85.40	C
127.09-91.90			B	1	0.65	1	1	1	118.708			
			C	1	0.65	1	1	1	118.708			
L3	1158.144	9599.062	A	1	0.65	1	1	1	176.444	3895.161	83.95	C
91.90-45.50			B	1	0.65	1	1	1	176.444			
			C	1	0.65	1	1	1	176.444			
L4 45.50-0.00	1135.687	14330.794	A	1	0.65	1	1	1	194.571	3516.437	77.28	C
			B	1	0.65	1	1	1	194.571			
			C	1	0.65	1	1	1	194.571			
Sum Weight:	4243.200	33205.682						OTM	1327.52	14685.120		

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft^2 kip-ft	F lb	w plf	Ctrl. Face

Tower Forces - No Ice - Wind 45 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
L1	1071.108	4317.331	A	1	0.65	1	1	1	153.245	4268.642	80.67	C
180.00-127.09			B	1	0.65	1	1	1	153.245			
			C	1	0.65	1	1	1	153.245			
L2	878.260	4958.495	A	1	0.65	1	1	1	118.708	3004.880	85.40	C
127.09-91.90			B	1	0.65	1	1	1	118.708			
			C	1	0.65	1	1	1	118.708			
L3	1158.144	9599.062	A	1	0.65	1	1	1	176.444	3895.161	83.95	C
91.90-45.50			B	1	0.65	1	1	1	176.444			
			C	1	0.65	1	1	1	176.444			
L4 45.50-0.00	1135.687	14330.794	A	1	0.65	1	1	1	194.571	3516.437	77.28	C
			B	1	0.65	1	1	1	194.571			
			C	1	0.65	1	1	1	194.571			
Sum Weight:	4243.200	33205.682						OTM	1327.52 kip-ft	14685.120		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
L1	1071.108	4317.331	A	1	0.65	1	1	1	153.245	4268.642	80.67	C
180.00-127.09			B	1	0.65	1	1	1	153.245			
			C	1	0.65	1	1	1	153.245			
L2	878.260	4958.495	A	1	0.65	1	1	1	118.708	3004.880	85.40	C
127.09-91.90			B	1	0.65	1	1	1	118.708			
			C	1	0.65	1	1	1	118.708			
L3	1158.144	9599.062	A	1	0.65	1	1	1	176.444	3895.161	83.95	C
91.90-45.50			B	1	0.65	1	1	1	176.444			
			C	1	0.65	1	1	1	176.444			
L4 45.50-0.00	1135.687	14330.794	A	1	0.65	1	1	1	194.571	3516.437	77.28	C
			B	1	0.65	1	1	1	194.571			
			C	1	0.65	1	1	1	194.571			
Sum Weight:	4243.200	33205.682						OTM	1327.52 kip-ft	14685.120		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	1071.108	4317.331	A	1	0.65	1	1	1	153.245	4268.642	80.67	C
180.00-127.09			B	1	0.65	1	1	1	153.245			
			C	1	0.65	1	1	1	153.245			
L2	878.260	4958.495	A	1	0.65	1	1	1	118.708	3004.880	85.40	C
127.09-91.90			B	1	0.65	1	1	1	118.708			
			C	1	0.65	1	1	1	118.708			
L3	1158.144	9599.062	A	1	0.65	1	1	1	176.444	3895.161	83.95	C
91.90-45.50			B	1	0.65	1	1	1	176.444			
			C	1	0.65	1	1	1	176.444			
L4 45.50-0.00	1135.687	14330.794	A	1	0.65	1	1	1	194.571	3516.437	77.28	C
			B	1	0.65	1	1	1	194.571			
			C	1	0.65	1	1	1	194.571			
Sum Weight:	4243.200	33205.682						OTM	1327.52 kip-ft	14685.120		

Tower Forces - With Ice - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	1071.108	5468.591	A	1	0.65	1	1	1	157.654	3293.597	62.25	C
180.00-127.09			B	1	0.65	1	1	1	157.654			
			C	1	0.65	1	1	1	157.654			
L2	878.260	5848.500	A	1	0.65	1	1	1	121.640	2309.326	65.63	C
127.09-91.90			B	1	0.65	1	1	1	121.640			
			C	1	0.65	1	1	1	121.640			
L3	1158.144	10920.128	A	1	0.65	1	1	1	180.311	2985.388	64.34	C
91.90-45.50			B	1	0.65	1	1	1	180.311			
			C	1	0.65	1	1	1	180.311			
L4 45.50-0.00	1135.687	15785.826	A	1	0.65	1	1	1	198.362	2688.720	59.09	C
			B	1	0.65	1	1	1	198.362			
			C	1	0.65	1	1	1	198.362			
Sum Weight:	4243.200	38023.045						OTM	1021.36 kip-ft	11277.031		

Tower Forces - With Ice - Wind 45 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	1071.108	5468.591	A	1	0.65	1	1	1	157.654	3293.597	62.25	C
180.00-127.09			B	1	0.65	1	1	1	157.654			
			C	1	0.65	1	1	1	157.654			
L2	878.260	5848.500	A	1	0.65	1	1	1	121.640	2309.326	65.63	C
127.09-91.90			B	1	0.65	1	1	1	121.640			
			C	1	0.65	1	1	1	121.640			
L3	1158.144	10920.128	A	1	0.65	1	1	1	180.311	2985.388	64.34	C
91.90-45.50			B	1	0.65	1	1	1	180.311			
			C	1	0.65	1	1	1	180.311			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
L4 45.50-0.00	1135.687	15785.826	A	1	0.65	1	1	1	198.362	2688.720	59.09	C
			B	1	0.65	1	1	1	198.362			
			C	1	0.65	1	1	1	198.362			
Sum Weight:	4243.200	38023.045						OTM	1021.36 kip-ft	11277.031		

Tower Forces - With Ice - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
L1	1071.108	5468.591	A	1	0.65	1	1	1	157.654	3293.597	62.25	C
180.00-127.09			B	1	0.65	1	1	1	157.654			
			C	1	0.65	1	1	1	157.654			
L2	878.260	5848.500	A	1	0.65	1	1	1	121.640	2309.326	65.63	C
127.09-91.90			B	1	0.65	1	1	1	121.640			
			C	1	0.65	1	1	1	121.640			
L3	1158.144	10920.128	A	1	0.65	1	1	1	180.311	2985.388	64.34	C
91.90-45.50			B	1	0.65	1	1	1	180.311			
			C	1	0.65	1	1	1	180.311			
L4 45.50-0.00	1135.687	15785.826	A	1	0.65	1	1	1	198.362	2688.720	59.09	C
			B	1	0.65	1	1	1	198.362			
			C	1	0.65	1	1	1	198.362			
Sum Weight:	4243.200	38023.045						OTM	1021.36 kip-ft	11277.031		

Tower Forces - With Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
L1	1071.108	5468.591	A	1	0.65	1	1	1	157.654	3293.597	62.25	C
180.00-127.09			B	1	0.65	1	1	1	157.654			
			C	1	0.65	1	1	1	157.654			
L2	878.260	5848.500	A	1	0.65	1	1	1	121.640	2309.326	65.63	C
127.09-91.90			B	1	0.65	1	1	1	121.640			
			C	1	0.65	1	1	1	121.640			
L3	1158.144	10920.128	A	1	0.65	1	1	1	180.311	2985.388	64.34	C
91.90-45.50			B	1	0.65	1	1	1	180.311			
			C	1	0.65	1	1	1	180.311			
L4 45.50-0.00	1135.687	15785.826	A	1	0.65	1	1	1	198.362	2688.720	59.09	C
			B	1	0.65	1	1	1	198.362			
			C	1	0.65	1	1	1	198.362			
Sum Weight:	4243.200	38023.045						OTM	1021.36 kip-ft	11277.031		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	1071.108	4317.331	A	1	0.65	1	1	1	153.245	1667.438	31.51	C
180.00-127.09			B	1	0.65	1	1	1	153.245			
			C	1	0.65	1	1	1	153.245			
L2	878.260	4958.495	A	1	0.65	1	1	1	118.708	1173.781	33.36	C
127.09-91.90			B	1	0.65	1	1	1	118.708			
			C	1	0.65	1	1	1	118.708			
L3	1158.144	9599.062	A	1	0.65	1	1	1	176.444	1521.547	32.79	C
91.90-45.50			B	1	0.65	1	1	1	176.444			
			C	1	0.65	1	1	1	176.444			
L4 45.50-0.00	1135.687	14330.794	A	1	0.65	1	1	1	194.571	1373.608	30.19	C
			B	1	0.65	1	1	1	194.571			
			C	1	0.65	1	1	1	194.571			
Sum Weight:	4243.200	33205.682						OTM	518.56 kip-ft	5736.375		

Tower Forces - Service - Wind 45 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	1071.108	4317.331	A	1	0.65	1	1	1	153.245	1667.438	31.51	C
180.00-127.09			B	1	0.65	1	1	1	153.245			
			C	1	0.65	1	1	1	153.245			
L2	878.260	4958.495	A	1	0.65	1	1	1	118.708	1173.781	33.36	C
127.09-91.90			B	1	0.65	1	1	1	118.708			
			C	1	0.65	1	1	1	118.708			
L3	1158.144	9599.062	A	1	0.65	1	1	1	176.444	1521.547	32.79	C
91.90-45.50			B	1	0.65	1	1	1	176.444			
			C	1	0.65	1	1	1	176.444			
L4 45.50-0.00	1135.687	14330.794	A	1	0.65	1	1	1	194.571	1373.608	30.19	C
			B	1	0.65	1	1	1	194.571			
			C	1	0.65	1	1	1	194.571			
Sum Weight:	4243.200	33205.682						OTM	518.56 kip-ft	5736.375		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	1071.108	4317.331	A	1	0.65	1	1	1	153.245	1667.438	31.51	C
180.00-127.09			B	1	0.65	1	1	1	153.245			
			C	1	0.65	1	1	1	153.245			
L2	878.260	4958.495	A	1	0.65	1	1	1	118.708	1173.781	33.36	C
127.09-91.90			B	1	0.65	1	1	1	118.708			
			C	1	0.65	1	1	1	118.708			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L3	1158.144	9599.062	A	1	0.65	1	1	1	176.444	1521.547	32.79	C
91.90-45.50			B	1	0.65	1	1	1	176.444			
			C	1	0.65	1	1	1	176.444			
L4 45.50-0.00	1135.687	14330.794	A	1	0.65	1	1	1	194.571	1373.608	30.19	C
			B	1	0.65	1	1	1	194.571			
			C	1	0.65	1	1	1	194.571			
Sum Weight:	4243.200	33205.682						OTM	518.56 kip-ft	5736.375		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	R_R	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
L1	1071.108	4317.331	A	1	0.65	1	1	1	153.245	1667.438	31.51	C
180.00-127.09			B	1	0.65	1	1	1	153.245			
			C	1	0.65	1	1	1	153.245			
L2	878.260	4958.495	A	1	0.65	1	1	1	118.708	1173.781	33.36	C
127.09-91.90			B	1	0.65	1	1	1	118.708			
			C	1	0.65	1	1	1	118.708			
L3	1158.144	9599.062	A	1	0.65	1	1	1	176.444	1521.547	32.79	C
91.90-45.50			B	1	0.65	1	1	1	176.444			
			C	1	0.65	1	1	1	176.444			
L4 45.50-0.00	1135.687	14330.794	A	1	0.65	1	1	1	194.571	1373.608	30.19	C
			B	1	0.65	1	1	1	194.571			
			C	1	0.65	1	1	1	194.571			
Sum Weight:	4243.200	33205.682						OTM	518.56 kip-ft	5736.375		

Force Totals

Load Case	Vertical Forces lb	Sum of Forces X lb	Sum of Forces Z lb	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Leg Weight	33205.682					
Bracing Weight	0.000					
Total Member Self-Weight	33205.682			-0.03	0.06	
Total Weight	41250.082			-0.03	0.06	
Wind 0 deg - No Ice		-44.517	-22620.193	-2675.10	7.18	0.07
Wind 30 deg - No Ice		11297.245	-19567.403	-2313.15	-1335.41	0.09
Wind 45 deg - No Ice		15999.761	-15963.413	-1886.55	-1892.27	0.08
Wind 60 deg - No Ice		19611.920	-11271.543	-1331.40	-2320.17	0.07
Wind 90 deg - No Ice		22671.597	44.517	7.09	-2683.23	0.04
Wind 120 deg - No Ice		19656.438	11348.650	1343.66	-2327.30	0.00
Wind 135 deg - No Ice		16062.719	16026.370	1896.56	-1902.35	-0.02
Wind 150 deg - No Ice		11374.352	19611.920	2320.20	-1347.75	-0.04
Wind 180 deg - No Ice		44.517	22620.193	2675.03	-7.06	-0.07
Wind 210 deg - No Ice		-11297.245	19567.403	2313.08	1335.54	-0.09
Wind 225 deg - No Ice		-15999.761	15963.413	1886.48	1892.39	-0.08

Load Case	Vertical Forces lb	Sum of Forces X lb	Sum of Forces Z lb	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Wind 240 deg - No Ice		-19611.920	11271.543	1331.33	2320.29	-0.07
Wind 270 deg - No Ice		-22671.597	-44.517	-7.16	2683.35	-0.04
Wind 300 deg - No Ice		-19656.438	-11348.650	-1343.73	2327.42	0.00
Wind 315 deg - No Ice		-16062.719	-16026.370	-1896.63	1902.47	0.02
Wind 330 deg - No Ice		-11374.352	-19611.920	-2320.27	1347.87	0.04
Member Ice	4817.363					
Total Weight Ice	48092.913			-0.05	0.09	
Wind 0 deg - Ice		-34.638	-18008.901	-2165.28	5.63	0.06
Wind 30 deg - Ice		8994.451	-15578.847	-1872.43	-1080.93	0.07
Wind 45 deg - Ice		12738.005	-12709.723	-1527.18	-1531.57	0.06
Wind 60 deg - Ice		15613.485	-8974.453	-1077.87	-1877.83	0.06
Wind 90 deg - Ice		18048.898	34.638	5.49	-2171.55	0.03
Wind 120 deg - Ice		15648.123	9034.448	1087.37	-1883.37	0.00
Wind 135 deg - Ice		12786.991	12758.709	1534.92	-1539.41	-0.02
Wind 150 deg - Ice		9054.447	15613.485	1877.87	-1090.53	-0.03
Wind 180 deg - Ice		34.638	18008.901	2165.18	-5.46	-0.06
Wind 210 deg - Ice		-8994.451	15578.847	1872.33	1081.10	-0.07
Wind 225 deg - Ice		-12738.005	12709.723	1527.08	1531.74	-0.06
Wind 240 deg - Ice		-15613.485	8974.453	1077.77	1878.00	-0.06
Wind 270 deg - Ice		-18048.898	-34.638	-5.59	2171.72	-0.03
Wind 300 deg - Ice		-15648.123	-9034.448	-1087.47	1883.55	0.00
Wind 315 deg - Ice		-12786.991	-12758.709	-1535.02	1539.58	0.02
Wind 330 deg - Ice		-9054.447	-15613.485	-1877.97	1090.70	0.03
Total Weight	41250.082			-0.03	0.06	
Wind 0 deg - Service		-17.390	-8836.013	-1044.98	2.84	0.03
Wind 30 deg - Service		4412.986	-7643.517	-903.59	-521.61	0.03
Wind 45 deg - Service		6249.907	-6235.708	-736.96	-739.13	0.03
Wind 60 deg - Service		7660.906	-4402.947	-520.10	-906.28	0.03
Wind 90 deg - Service		8856.093	17.390	2.75	-1048.10	0.02
Wind 120 deg - Service		7678.296	4433.066	524.85	-909.06	0.00
Wind 135 deg - Service		6274.499	6260.301	740.82	-743.07	-0.01
Wind 150 deg - Service		4443.106	7660.906	906.31	-526.43	-0.02
Wind 180 deg - Service		17.390	8836.013	1044.91	-2.72	-0.03
Wind 210 deg - Service		-4412.986	7643.517	903.52	521.73	-0.03
Wind 225 deg - Service		-6249.907	6235.708	736.89	739.25	-0.03
Wind 240 deg - Service		-7660.906	4402.947	520.03	906.40	-0.03
Wind 270 deg - Service		-8856.093	-17.390	-2.82	1048.22	-0.02
Wind 300 deg - Service		-7678.296	-4433.066	-524.92	909.18	0.00
Wind 315 deg - Service		-6274.499	-6260.301	-740.89	743.19	0.01
Wind 330 deg - Service		-4443.106	-7660.906	-906.38	526.55	0.02

Load Combinations

Comb. No.	Description
1	Dead Only
2	Dead+Wind 0 deg - No Ice
3	Dead+Wind 30 deg - No Ice
4	Dead+Wind 45 deg - No Ice
5	Dead+Wind 60 deg - No Ice
6	Dead+Wind 90 deg - No Ice
7	Dead+Wind 120 deg - No Ice
8	Dead+Wind 135 deg - No Ice
9	Dead+Wind 150 deg - No Ice
10	Dead+Wind 180 deg - No Ice
11	Dead+Wind 210 deg - No Ice

Comb. No.	Description
12	Dead+Wind 225 deg - No Ice
13	Dead+Wind 240 deg - No Ice
14	Dead+Wind 270 deg - No Ice
15	Dead+Wind 300 deg - No Ice
16	Dead+Wind 315 deg - No Ice
17	Dead+Wind 330 deg - No Ice
18	Dead+Ice+Temp
19	Dead+Wind 0 deg+Ice+Temp
20	Dead+Wind 30 deg+Ice+Temp
21	Dead+Wind 45 deg+Ice+Temp
22	Dead+Wind 60 deg+Ice+Temp
23	Dead+Wind 90 deg+Ice+Temp
24	Dead+Wind 120 deg+Ice+Temp
25	Dead+Wind 135 deg+Ice+Temp
26	Dead+Wind 150 deg+Ice+Temp
27	Dead+Wind 180 deg+Ice+Temp
28	Dead+Wind 210 deg+Ice+Temp
29	Dead+Wind 225 deg+Ice+Temp
30	Dead+Wind 240 deg+Ice+Temp
31	Dead+Wind 270 deg+Ice+Temp
32	Dead+Wind 300 deg+Ice+Temp
33	Dead+Wind 315 deg+Ice+Temp
34	Dead+Wind 330 deg+Ice+Temp
35	Dead+Wind 0 deg - Service
36	Dead+Wind 30 deg - Service
37	Dead+Wind 45 deg - Service
38	Dead+Wind 60 deg - Service
39	Dead+Wind 90 deg - Service
40	Dead+Wind 120 deg - Service
41	Dead+Wind 135 deg - Service
42	Dead+Wind 150 deg - Service
43	Dead+Wind 180 deg - Service
44	Dead+Wind 210 deg - Service
45	Dead+Wind 225 deg - Service
46	Dead+Wind 240 deg - Service
47	Dead+Wind 270 deg - Service
48	Dead+Wind 300 deg - Service
49	Dead+Wind 315 deg - Service
50	Dead+Wind 330 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force lb	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	180 - 127.087	Pole	Max Tension	1	0.000	0.00	0.00
			Max. Compression	18	-11588.125	0.09	0.05
			Max. Mx	14	-7877.132	395.87	1.29
			Max. My	2	-7882.428	1.31	394.40
			Max. Vy	14	-12216.629	395.87	1.29
			Max. Vx	2	-12163.743	1.31	394.40
			Max. Torque	3			-0.08
L2	127.087 - 91.9003	Pole	Max Tension	1	0.000	0.00	0.00
			Max. Compression	18	-17924.989	0.09	0.05
			Max. Mx	14	-13406.921	870.89	2.88
			Max. My	2	-13411.237	2.91	867.59
			Max. Vy	14	-15264.476	870.89	2.88
			Max. Vx	2	-15211.198	2.91	867.59

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Force lb	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Torque	3			-0.08
L3	91.9003 - 45.5003	Pole	Max Tension	1	0.000	0.00	0.00
			Max. Compression	18	-29362.374	0.09	0.05
			Max. Mx	14	-23787.359	1657.19	4.99
			Max. My	2	-23789.804	5.02	1651.46
			Max. Vy	14	-19065.411	1657.19	4.99
			Max. Vx	2	-19012.347	5.02	1651.46
			Max. Torque	3			-0.08
L4	45.5003 - 0	Pole	Max Tension	1	0.000	0.00	0.00
			Max. Compression	18	-48092.913	0.09	0.05
			Max. Mx	14	-41238.252	2761.91	7.39
			Max. My	2	-41238.315	7.42	2753.41
			Max. Vy	14	-22693.111	2761.91	7.39
			Max. Vx	2	-22641.640	7.42	2753.41
			Max. Torque	3			-0.08

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
Pole	Max. Vert	31	48092.913	18048.904	34.638
	Max. H_x	14	41250.082	22671.600	44.517
	Max. H_z	2	41250.082	44.517	22620.196
	Max. M_x	2	2753.41	44.517	22620.196
	Max. M_z	6	2761.78	-22671.600	-44.517
	Max. Torsion	11	0.08	11297.245	-19567.403
	Min. Vert	1	41250.082	0.000	0.000
	Min. H_x	6	41250.082	-22671.600	-44.517
	Min. H_z	10	41250.082	-44.517	-22620.196
	Min. M_x	10	-2753.33	-44.517	-22620.196
	Min. M_z	14	-2761.91	22671.600	44.517
	Min. Torsion	3	-0.08	-11297.245	19567.403

Tower Mast Reaction Summary

Load Combination	Vertical lb	$Shear_x$ lb	$Shear_z$ lb	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	41250.082	0.000	0.000	-0.03	0.06	0.00
Dead+Wind 0 deg - No Ice	41250.082	-44.517	-22620.196	-2753.41	7.42	0.07
Dead+Wind 30 deg - No Ice	41250.082	11297.245	-19567.403	-2380.86	-1374.50	0.08
Dead+Wind 45 deg - No Ice	41250.082	15999.761	-15963.413	-1941.77	-1947.67	0.08
Dead+Wind 60 deg - No Ice	41250.082	19611.920	-11271.543	-1370.36	-2388.10	0.07
Dead+Wind 90 deg - No Ice	41250.082	22671.600	44.517	7.31	-2761.78	0.04
Dead+Wind 120 deg - No Ice	41250.082	19656.438	11348.650	1383.01	-2395.44	0.00
Dead+Wind 135 deg - No Ice	41250.082	16062.719	16026.370	1952.08	-1958.05	-0.02
Dead+Wind 150 deg - No Ice	41250.082	11374.352	19611.920	2388.12	-1387.23	-0.04
Dead+Wind 180 deg - No Ice	41250.082	44.517	22620.196	2753.33	-7.29	-0.07
Dead+Wind 210 deg - No Ice	41250.082	-11297.245	19567.403	2380.78	1374.63	-0.08
Dead+Wind 225 deg - No Ice	41250.082	-15999.761	15963.413	1941.70	1947.80	-0.08
Dead+Wind 240 deg - No Ice	41250.082	-19611.920	11271.543	1370.28	2388.23	-0.07

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	lb	lb	lb	kip-ft	kip-ft	kip-ft
Dead+Wind 270 deg - No Ice	41250.082	-22671.600	-44.517	-7.39	2761.91	-0.04
Dead+Wind 300 deg - No Ice	41250.082	-19656.438	-11348.650	-1383.08	2395.56	0.00
Dead+Wind 315 deg - No Ice	41250.082	-16062.719	-16026.370	-1952.15	1958.18	0.02
Dead+Wind 330 deg - No Ice	41250.082	-11374.352	-19611.920	-2388.19	1387.35	0.04
Dead+Ice+Temp	48092.913	0.000	0.000	-0.05	0.09	0.00
Dead+Wind 0 deg+Ice+Temp	48092.913	-34.638	-18008.907	-2248.23	5.87	0.05
Dead+Wind 30 deg+Ice+Temp	48092.913	8994.454	-15578.852	-1944.15	-1122.33	0.06
Dead+Wind 45 deg+Ice+Temp	48092.913	12738.009	-12709.727	-1585.67	-1590.24	0.06
Dead+Wind 60 deg+Ice+Temp	48092.913	15613.490	-8974.456	-1119.14	-1949.77	0.05
Dead+Wind 90 deg+Ice+Temp	48092.913	18048.904	34.638	5.72	-2254.74	0.03
Dead+Wind 120 deg+Ice+Temp	48092.913	15648.129	9034.451	1129.03	-1955.54	0.00
Dead+Wind 135 deg+Ice+Temp	48092.913	12786.995	12758.713	1593.72	-1598.40	-0.02
Dead+Wind 150 deg+Ice+Temp	48092.913	9054.450	15613.490	1949.80	-1132.33	-0.03
Dead+Wind 180 deg+Ice+Temp	48092.913	34.638	18008.907	2248.12	-5.68	-0.05
Dead+Wind 210 deg+Ice+Temp	48092.913	-8994.454	15578.852	1944.04	1122.52	-0.06
Dead+Wind 225 deg+Ice+Temp	48092.913	-12738.009	12709.727	1585.57	1590.43	-0.06
Dead+Wind 240 deg+Ice+Temp	48092.913	-15613.490	8974.456	1119.03	1949.96	-0.05
Dead+Wind 270 deg+Ice+Temp	48092.913	-18048.904	-34.638	-5.83	2254.93	-0.03
Dead+Wind 300 deg+Ice+Temp	48092.913	-15648.129	-9034.451	-1129.14	1955.72	0.00
Dead+Wind 315 deg+Ice+Temp	48092.913	-12786.995	-12758.713	-1593.83	1598.58	0.02
Dead+Wind 330 deg+Ice+Temp	48092.913	-9054.450	-15613.490	-1949.91	1132.51	0.03
Dead+Wind 0 deg - Service	41250.082	-17.390	-8836.014	-1076.18	2.94	0.03
Dead+Wind 30 deg - Service	41250.082	4412.987	-7643.518	-930.57	-537.18	0.03
Dead+Wind 45 deg - Service	41250.082	6249.908	-6235.709	-758.95	-761.20	0.03
Dead+Wind 60 deg - Service	41250.082	7660.907	-4402.947	-535.62	-933.34	0.03
Dead+Wind 90 deg - Service	41250.082	8856.094	17.390	2.84	-1079.39	0.02
Dead+Wind 120 deg - Service	41250.082	7678.297	4433.067	540.52	-936.21	0.00
Dead+Wind 135 deg - Service	41250.082	6274.500	6260.302	762.94	-765.26	-0.01
Dead+Wind 150 deg - Service	41250.082	4443.107	7660.907	933.36	-542.15	-0.02
Dead+Wind 180 deg - Service	41250.082	17.390	8836.014	1076.10	-2.81	-0.03
Dead+Wind 210 deg - Service	41250.082	-4412.987	7643.518	930.49	537.31	-0.03
Dead+Wind 225 deg - Service	41250.082	-6249.908	6235.709	758.88	761.33	-0.03
Dead+Wind 240 deg - Service	41250.082	-7660.907	4402.947	535.55	933.47	-0.03
Dead+Wind 270 deg - Service	41250.082	-8856.094	-17.390	-2.91	1079.52	-0.02
Dead+Wind 300 deg - Service	41250.082	-7678.297	-4433.067	-540.60	936.34	0.00
Dead+Wind 315 deg - Service	41250.082	-6274.500	-6260.302	-763.01	765.39	0.01
Dead+Wind 330 deg - Service	41250.082	-4443.107	-7660.907	-933.44	542.28	0.02

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX	PY	PZ	PX	PY	PZ	% Error
	lb	lb	lb	lb	lb	lb	
1	0.000	-41250.082	0.000	0.000	41250.082	0.000	0.000%
2	-44.517	-41250.082	-22620.193	44.517	41250.082	22620.196	0.000%
3	11297.245	-41250.082	-19567.403	-11297.245	41250.082	19567.403	0.000%
4	15999.761	-41250.082	-15963.413	-15999.761	41250.082	15963.413	0.000%
5	19611.920	-41250.082	-11271.543	-19611.920	41250.082	11271.543	0.000%
6	22671.597	-41250.082	44.517	-22671.600	41250.082	-44.517	0.000%
7	19656.438	-41250.082	11348.650	-19656.438	41250.082	-11348.650	0.000%
8	16062.719	-41250.082	16026.370	-16062.719	41250.082	-16026.370	0.000%
9	11374.352	-41250.082	19611.920	-11374.352	41250.082	-19611.920	0.000%
10	44.517	-41250.082	22620.193	-44.517	41250.082	-22620.196	0.000%
11	-11297.245	-41250.082	19567.403	11297.245	41250.082	-19567.403	0.000%
12	-15999.761	-41250.082	15963.413	15999.761	41250.082	-15963.413	0.000%
13	-19611.920	-41250.082	11271.543	19611.920	41250.082	-11271.543	0.000%
14	-22671.597	-41250.082	-44.517	22671.600	41250.082	44.517	0.000%
15	-19656.438	-41250.082	-11348.650	19656.438	41250.082	11348.650	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX lb	PY lb	PZ lb	PX lb	PY lb	PZ lb	% Error
16	-16062.719	-41250.082	-16026.370	16062.719	41250.082	16026.370	0.000%
17	-11374.352	-41250.082	-19611.920	11374.352	41250.082	19611.920	0.000%
18	0.000	-48092.913	0.000	0.000	48092.913	0.000	0.000%
19	-34.638	-48092.913	-18008.901	34.638	48092.913	18008.907	0.000%
20	8994.451	-48092.913	-15578.847	-8994.454	48092.913	15578.852	0.000%
21	12738.005	-48092.913	-12709.723	-12738.009	48092.913	12709.727	0.000%
22	15613.485	-48092.913	-8974.453	-15613.490	48092.913	8974.456	0.000%
23	18048.898	-48092.913	34.638	-18048.904	48092.913	-34.638	0.000%
24	15648.123	-48092.913	9034.448	-15648.129	48092.913	-9034.451	0.000%
25	12786.991	-48092.913	12758.709	-12786.995	48092.913	-12758.713	0.000%
26	9054.447	-48092.913	15613.485	-9054.450	48092.913	-15613.490	0.000%
27	34.638	-48092.913	18008.901	-34.638	48092.913	-18008.907	0.000%
28	-8994.451	-48092.913	15578.847	8994.454	48092.913	-15578.852	0.000%
29	-12738.005	-48092.913	12709.723	12738.009	48092.913	-12709.727	0.000%
30	-15613.485	-48092.913	8974.453	15613.490	48092.913	-8974.456	0.000%
31	-18048.898	-48092.913	-34.638	18048.904	48092.913	34.638	0.000%
32	-15648.123	-48092.913	-9034.448	15648.129	48092.913	9034.451	0.000%
33	-12786.991	-48092.913	-12758.709	12786.995	48092.913	12758.713	0.000%
34	-9054.447	-48092.913	-15613.485	9054.450	48092.913	15613.490	0.000%
35	-17.390	-41250.082	-8836.013	17.390	41250.082	8836.014	0.000%
36	4412.986	-41250.082	-7643.517	-4412.987	41250.082	7643.518	0.000%
37	6249.907	-41250.082	-6235.708	-6249.908	41250.082	6235.709	0.000%
38	7660.906	-41250.082	-4402.947	-7660.907	41250.082	4402.947	0.000%
39	8856.093	-41250.082	17.390	-8856.094	41250.082	-17.390	0.000%
40	7678.296	-41250.082	4433.066	-7678.297	41250.082	-4433.067	0.000%
41	6274.499	-41250.082	6260.301	-6274.500	41250.082	-6260.302	0.000%
42	4443.106	-41250.082	7660.906	-4443.107	41250.082	-7660.907	0.000%
43	17.390	-41250.082	8836.013	-17.390	41250.082	-8836.014	0.000%
44	-4412.986	-41250.082	7643.517	4412.987	41250.082	-7643.518	0.000%
45	-6249.907	-41250.082	6235.708	6249.908	41250.082	-6235.709	0.000%
46	-7660.906	-41250.082	4402.947	7660.907	41250.082	-4402.947	0.000%
47	-8856.093	-41250.082	-17.390	8856.094	41250.082	17.390	0.000%
48	-7678.296	-41250.082	-4433.066	7678.297	41250.082	4433.067	0.000%
49	-6274.499	-41250.082	-6260.301	6274.500	41250.082	6260.302	0.000%
50	-4443.106	-41250.082	-7660.906	4443.107	41250.082	7660.907	0.000%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	4	0.00000001	0.00000001
2	Yes	4	0.00000001	0.00009186
3	Yes	5	0.00000001	0.00026079
4	Yes	5	0.00000001	0.00029475
5	Yes	5	0.00000001	0.00025999
6	Yes	4	0.00000001	0.00011209
7	Yes	5	0.00000001	0.00026433
8	Yes	5	0.00000001	0.00029868
9	Yes	5	0.00000001	0.00026434
10	Yes	4	0.00000001	0.00011911
11	Yes	5	0.00000001	0.00025967
12	Yes	5	0.00000001	0.00029478
13	Yes	5	0.00000001	0.00026101
14	Yes	4	0.00000001	0.00009604
15	Yes	5	0.00000001	0.00026441
16	Yes	5	0.00000001	0.00029877

17	Yes	5	0.00000001	0.00026385
18	Yes	4	0.00000001	0.00000001
19	Yes	5	0.00000001	0.00017398
20	Yes	5	0.00000001	0.00046276
21	Yes	5	0.00000001	0.00052219
22	Yes	5	0.00000001	0.00046213
23	Yes	5	0.00000001	0.00017437
24	Yes	5	0.00000001	0.00046821
25	Yes	5	0.00000001	0.00052806
26	Yes	5	0.00000001	0.00046820
27	Yes	5	0.00000001	0.00017399
28	Yes	5	0.00000001	0.00046188
29	Yes	5	0.00000001	0.00052226
30	Yes	5	0.00000001	0.00046300
31	Yes	5	0.00000001	0.00017438
32	Yes	5	0.00000001	0.00046842
33	Yes	5	0.00000001	0.00052829
34	Yes	5	0.00000001	0.00046793
35	Yes	4	0.00000001	0.00004179
36	Yes	4	0.00000001	0.00063398
37	Yes	4	0.00000001	0.00072816
38	Yes	4	0.00000001	0.00062946
39	Yes	4	0.00000001	0.00004250
40	Yes	4	0.00000001	0.00064319
41	Yes	4	0.00000001	0.00074025
42	Yes	4	0.00000001	0.00064366
43	Yes	4	0.00000001	0.00004278
44	Yes	4	0.00000001	0.00062828
45	Yes	4	0.00000001	0.00072836
46	Yes	4	0.00000001	0.00063472
47	Yes	4	0.00000001	0.00004193
48	Yes	4	0.00000001	0.00064373
49	Yes	4	0.00000001	0.00074087
50	Yes	4	0.00000001	0.00064130

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	180 - 127.087	31.394	48	1.4620	0.0002
L2	132.92 - 91.9003	17.648	48	1.2484	0.0001
L3	98.4003 - 45.5003	9.644	48	0.9251	0.0001
L4	52.7503 - 0	2.777	48	0.4717	0.0000

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
184.00	Lightning Rod 2"x8'	48	31.394	1.4620	0.0002	62849
180.50	PiROD 13' Low Profile Platform (Monopole)	48	31.394	1.4620	0.0002	62849
180.00	(4) 7770	48	31.394	1.4620	0.0002	62849
160.00	PiROD 13' Low Profile Platform	48	25.323	1.3943	0.0002	15712

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
	(Monopole)					

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	180 - 127.087	80.232	15	3.7379	0.0005
L2	132.92 - 91.9003	45.120	15	3.1922	0.0003
L3	98.4003 - 45.5003	24.664	15	2.3659	0.0002
L4	52.7503 - 0	7.105	15	1.2067	0.0001

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
184.00	Lightning Rod 2"x8'	15	80.232	3.7379	0.0005	24793
180.50	PiROD 13' Low Profile Platform (Monopole)	15	80.232	3.7379	0.0005	24793
180.00	(4) 7770	15	80.232	3.7379	0.0005	24793
160.00	PiROD 13' Low Profile Platform (Monopole)	15	64.726	3.5651	0.0004	6196

Compression Checks

Pole Design Data

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	F_a ksi	A in^2	Actual P lb	Allow. P_a lb	Ratio $\frac{P}{P_a}$
L1	180 - 127.087 (1)	TP38.458x31.05x0.2188	52.91	180.00	162.6	5.649	25.9830	-7874.460	146776.000	0.054
L2	127.087 - 91.9003 (2)	TP42.947x37.2038x0.2813	41.02	180.00	145.7	7.033	37.2748	-13404.700	262148.000	0.051
L3	91.9003 - 45.5003 (3)	TP48.88x41.4744x0.375	52.90	180.00	128.1	9.097	56.5250	-23786.100	514217.000	0.046
L4	45.5003 - 0 (4)	TP54.5x47.1151x0.5	52.75	180.00	112.7	11.762	85.6980	-41238.199	1008000.000	0.041

Pole Bending Design Data

Section No.	Elevation ft	Size	Actual M_x kip-ft	Actual f_{bx} ksi	Allow. F_{bx} ksi	Ratio $\frac{f_{bx}}{F_{bx}}$	Actual M_y kip-ft	Actual f_{by} ksi	Allow. F_{by} ksi	Ratio $\frac{f_{by}}{F_{by}}$
L1	180 - 127.087 (1)	TP38.458x31.05x0.2188	396.60	19.795	36.649	0.540	0.00	0.000	36.649	0.000
L2	127.087 - 91.9003 (2)	TP42.947x37.2038x0.2813	872.53	27.232	39.000	0.698	0.00	0.000	39.000	0.000
L3	91.9003 - 45.5003 (3)	TP48.88x41.4744x0.375	1660.06	30.075	39.000	0.771	0.00	0.000	39.000	0.000
L4	45.5003 - 0 (4)	TP54.5x47.1151x0.5	2766.16	29.109	39.000	0.746	0.00	0.000	39.000	0.000

Pole Shear Design Data

Section No.	Elevation ft	Size	Actual V lb	Actual f_v ksi	Allow. F_v ksi	Ratio $\frac{f_v}{F_v}$	Actual T kip-ft	Actual f_{vt} ksi	Allow. F_{vt} ksi	Ratio $\frac{f_{vt}}{F_{vt}}$
L1	180 - 127.087 (1)	TP38.458x31.05x0.2188	12243.200	0.471	26.000	0.036	0.00	0.000	26.000	0.000
L2	127.087 - 91.9003 (2)	TP42.947x37.2038x0.2813	15291.200	0.410	26.000	0.032	0.00	0.000	26.000	0.000
L3	91.9003 - 45.5003 (3)	TP48.88x41.4744x0.375	19091.900	0.338	26.000	0.026	0.00	0.000	26.000	0.000
L4	45.5003 - 0 (4)	TP54.5x47.1151x0.5	22718.801	0.265	26.000	0.020	0.00	0.000	26.000	0.000

Pole Interaction Design Data

Section No.	Elevation ft	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Ratio $\frac{f_v}{F_v}$	Ratio $\frac{f_{vt}}{F_{vt}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
L1	180 - 127.087 (1)	0.054	0.540	0.000	0.036	0.000	0.594 ✔	1.333	H1-3+VT ✔
L2	127.087 - 91.9003 (2)	0.051	0.698	0.000	0.032	0.000	0.750 ✔	1.333	H1-3+VT ✔
L3	91.9003 - 45.5003 (3)	0.046	0.771	0.000	0.026	0.000	0.818 ✔	1.333	H1-3+VT ✔
L4	45.5003 - 0 (4)	0.041	0.746	0.000	0.020	0.000	0.787 ✔	1.333	H1-3+VT ✔

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	$SF*P_{allow}$ lb	% Capacity	Pass Fail
L1	180 - 127.087	Pole	TP38.458x31.05x0.2188	1	-7874.460	195652.400	44.6	Pass
L2	127.087 - 91.9003	Pole	TP42.947x37.2038x0.2813	2	-13404.700	349443.269	56.2	Pass
L3	91.9003 -	Pole	TP48.88x41.4744x0.375	3	-23786.100	685451.233	61.3	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	$SF*P_{allow}$ lb	% Capacity	Pass Fail
	45.5003							
L4	45.5003 - 0	Pole	TP54.5x47.1151x0.5	4	-41238.199	1343663.944	59.1	Pass
							Summary	
						Pole (L3)	61.3	Pass
						RATING =	**61.3**	**Pass**

ANCHOR BOLT AND
BASE PLATE ANALYSIS

URS

Job	180' Monopole - Norfolk, CT	Project No.	VZ5-167	Page / Sheet	of / 1 of 6
Description	Anchor Bolt and Base Plate Analysis	Computed by	CAR	Date	10/15/13
		Checked by		Date	

ANCHOR BOLT AND BASE PLATE ANALYSIS

Input Data

Tower Reactions:

Overturning Moment:	$OM := 2766 \cdot ft \cdot kips$	*user input*
Shear Force:	$Shear := 22.7 \cdot kips$	*user input*
Axial Force:	$Axial := 41.2 \cdot kips$	*user input*

Anchor Bolt Data:

Use ASTM A615 Grade 75

Number of Anchor Bolts = N	$N := 20$	*user input*
Diameter of Bolt Circle:	$D_{bc} := 61.84in$	*user input*
Bolt "Column" Distance:	$l := 3in$	*user input*
Bolt Ultimate Strength:	$F_u := 100 \cdot ksi$	*user input*
Bolt Yield Strength:	$Fy := 75 \cdot ksi$	*user input*
Bolt Modulus:	$E := 29000 \cdot ksi$	*user input*
Thickness Of Anchor Bolts	$D := 2.25in$	*user input*
Threads per Inch:	$n := 4.5$	*user input*

Base Plate Data:

Plate Yield Strength:	$Fy_{bp} := 60 \cdot ksi$	*user input*
Base Plate Thickness:	$PlateThickness := 2.75 \cdot in$	*user input*
Base Plate Diameter:	$D_{bp} := 68.89 \cdot in$	*user input*
Outer Pole Diameter:	$D_{pole} := 54.5in$	*user input*

Geometric Layout Data:

Distance from the center of gravity of the group to bolt in question = d(i)

Radius of Bolt Circle: $R_{bc} := \frac{D_{bc}}{2}$

Distance to Bolts: $i := 1 .. N$

$$d_i := \left| \begin{array}{l} \theta \leftarrow 2 \cdot \pi \cdot \left(\frac{i}{N}\right) \\ d \leftarrow R_{bc} \cdot \sin(\theta) \end{array} \right.$$

$d_1 = 9.55 \cdot in$ $d_7 = 25.01 \cdot in$

$d_2 = 18.17 \cdot in$ $d_8 = 18.17 \cdot in$

$d_3 = 25.01 \cdot in$ $d_9 = 9.55 \cdot in$

$d_4 = 29.41 \cdot in$ $d_{10} = 0.00 \cdot in$

$d_5 = 30.92 \cdot in$ $d_{11} = -9.55 \cdot in$

$d_6 = 29.41 \cdot in$ etc.

Critical Distances For Bending in Plate:

Outer Pole Radius: $R_{pole} := \frac{D_{pole}}{2}$ $R_{pole} = 27.25 \cdot in$

Moment Arms of Bolts about Neutral Axis: $MA_i := if\left(d_i \geq R_{pole}, d_i - R_{pole}, 0in\right)$

$MA_1 = 0.00 \cdot in$ $MA_7 = 0.00 \cdot in$

$MA_2 = 0.00 \cdot in$ $MA_8 = 0.00 \cdot in$

$MA_3 = 0.00 \cdot in$ $MA_9 = 0.00 \cdot in$

$MA_4 = 2.16 \cdot in$ $MA_{10} = 0.00 \cdot in$

$MA_5 = 3.67 \cdot in$ $MA_{11} = 0.00 \cdot in$

$MA_6 = 2.16 \cdot in$ etc.

Effective Width of Baseplate for Bending: $EffectiveWidth := .90 \cdot 2 \cdot \sqrt{\left(\frac{D_{bp}}{2}\right)^2 - \left(\frac{D_{pole}}{2}\right)^2}$ $EffectiveWidth = 37.92 \cdot in$

Anchor Bolt Analysis:

Polar Moment of Inertia I_p:

$$I_p := \sum_i \left(d_i\right)^2 \qquad I_p = 9.560 \times 10^3 \cdot in^2$$

Gross Area of Bolt:

$$A_g := \frac{\pi}{4} \cdot D^2 \qquad A_g = 3.976 \cdot in^2$$

Net Area of Bolt:

$$A_n := \frac{\pi}{4} \cdot \left(D - \frac{0.9743 \cdot in}{n}\right)^2 \qquad A_n = 3.248 \cdot in^2$$

Net Diameter:

$$D_n := \frac{2 \cdot \sqrt{A_n}}{\sqrt{\pi}} \qquad D_n = 2.03 \cdot in$$

Radius of Gyration of Bolt:

$$r := \frac{D_n}{4} \qquad r = 0.51 \cdot in$$

Section Modulus of Bolt:

$$S_x := \frac{\pi \cdot D_n^{\,3}}{32} \qquad S_x = 0.826 \cdot in^3$$

Anchor Bolt Bending Stress:

Maximum Applied Bending:

$$M_x := \left(\frac{Shear}{N}\right) \cdot 1 \qquad M_x = 0.284 \cdot ft \cdot kips$$

$$f_{bx} := \frac{M_x}{S_x} \qquad f_{bx} = 4.1 \cdot ksi$$

Allowable Bending

$$F_{bx} := 1.33 \cdot 0.60 \cdot Fy \qquad F_{bx} = 59.9 \cdot ksi$$

Note: 1.33 increase allowed per TIA/EIA

Check Tensile Forces:

Maximum Tensile Force (Gross Area):

$AllowableTension := 1.33 \cdot (0.33 \cdot A_g \cdot F_u)$ $\quad AllowableTension = 174.5 \cdot kips$

Note: 1.33 increase allowed per TIA/EIA

Maximum Tensile Force (Net Area):

$F_{net.area} := 1.33 \cdot (0.60 \cdot A_n \cdot Fy)$ $\quad F_{net.area} = 194.4 \cdot kips$

Note: 1.33 increase allowed per TIA/EIA

Applied Tension:

$$MaxTension := \frac{OM \cdot R_{bc}}{I_p} - \frac{Axial}{N} \qquad MaxTension = 105.3 \cdot kips$$

Check Stresses:

Note: Bolts supplied are "upset bolts." Use net area for checking per AISC.

$$\frac{MaxTension}{F_{net.area}} = 0.5$$

$$Condition := if\left(\frac{MaxTension}{F_{net.area}} \le 1.00, "OK", "Overstressed"\right)$$

Condition = "OK"

Check Compression & Combined Stresses (if required):

Check to see if a complete combined stress analysis is required:

Per ASCE Manual 72: "If the clearance between the base plate and concrete does not exceed two times the bolt diameter a bending stress analysis of the bolts is NOT normally required."

Set the clear space between the plate and bolt to zero and remove bending stresses if a combined stress analysis is not required:

$$l := \begin{cases} l & \text{if } l > 2 \cdot D_n \\ 0.00\text{in} & \text{otherwise} \end{cases} \qquad l = 0.00 \cdot \text{in}$$

$$f_{bx} := \begin{cases} f_{bx} & \text{if } l > 2 \cdot D_n \\ 0.0\text{ksi} & \text{otherwise} \end{cases} \qquad f_{bx} = 0.0 \cdot \text{ksi}$$

Allowable Compressive Force:

$$K := 0.65$$

$$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{Fy}} \qquad C_c = 87.36$$

$$F_a := \begin{cases} \dfrac{\left[1 - \dfrac{\left(\frac{K \cdot l}{r}\right)^2}{2 \cdot C_c^{\,2}}\right] \cdot Fy}{\dfrac{5}{3} + \dfrac{3 \cdot \left(\frac{K \cdot l}{r}\right)}{8 \cdot C_c} - \dfrac{\left(\frac{K \cdot l}{r}\right)^3}{8 \cdot C_c^{\,3}}} & \text{if } \dfrac{K \cdot l}{r} \le C_c \\ \dfrac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot l}{r}\right)^2} & \text{if } \dfrac{K \cdot l}{r} > C_c \end{cases} \qquad F_a = 45.0 \cdot \text{ksi}$$

$$F_a := 1.33 \cdot F_a \qquad \text{Note: 1.33 increase allowed per TIA/EIA} \qquad F_a = 59.9 \cdot \text{ksi}$$

Applied Compressive Force:

$$\text{MaxCompression} := \frac{OM \cdot R_{bc}}{I_p} + \frac{\text{Axial}}{N} \qquad \text{MaxCompression} = 109.4 \cdot \text{kips}$$

$$f_a := \frac{\text{MaxCompression}}{A_n} \qquad f_a = 33.7 \cdot \text{ksi}$$

Check Combined Stresses:

$$\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} = 0.56$$

$$\text{Condition} := \text{if}\left(\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} \le 1.00, \text{"OK"}, \text{"Overstressed"}\right) \qquad \boxed{\text{Condition} = \text{"OK"}}$$

Base Plate Analysis:

Force from Bolt(s):

$$C_i := \frac{OM \cdot d_i}{I_p} + \frac{Axial}{N}$$

$C_1 = 35.2 \cdot kips$ $C_7 = 88.9 \cdot kips$

$C_2 = 65.2 \cdot kips$ $C_8 = 65.2 \cdot kips$

$C_3 = 88.9 \cdot kips$ $C_9 = 35.2 \cdot kips$

$C_4 = 104.2 \cdot kips$ $C_{10} = 2.1 \cdot kips$

$C_5 = 109.4 \cdot kips$ $C_{11} = -31.1 \cdot kips$

$C_6 = 104.2 \cdot kips$ etc.

Bending Stress in Plate:

$$f_{bp} := \sum_i \frac{6 \cdot C_i \cdot MA_i}{EffectiveWidth \cdot PlateThickness^2}$$

$f_{bp} = 17.8 \cdot ksi$

Check Stresses:

$$\frac{f_{bp}}{1.33 \cdot 0.75 Fy_{bp}} = 0.30$$

$$Condition := if\left(\frac{f_{bp}}{1.33 \cdot 0.75 Fy_{bp}} < 1.00, "OK", "Overstressed"\right)$$

Condition = "OK"

FOUNDATION ANALYSIS

URS

Job	180' Monopole - Norfolk, CT	Project No.	VZ5-167	Page	of
Description	Spread Footing w/ Pier Analysis	Computed by	CAR	Sheet 1	of 6
		Checked by		Date	10/15/13
				Date	

MONOPOLE FOUNDATION ANALYSIS

TOWER FORCES:

Moment Caused by Tower	$M_t := 2766 \cdot ft \cdot kips$
Shear at Base of Tower	$S_t := 22.7kip$
Max Compressive Force	$C_{.t} := 41.2 \cdot kip$
Height of Tower	$H_t := 180 \cdot ft$
Base Plate Bolt Circle	$MP := 61.84in$

FOOTING DIMENSIONS:

Overall Depth of Footing	$D_f := 4.5ft$
Length of Pier	$L_p := 0 \cdot ft$
Extension of Pier Above Grade	$L_{pag} := 0 \cdot ft$
Diameter of Pier	$d_p := 0 \cdot ft$
Thickness of Footing	$T_f := 4.5 \cdot ft$
Width of Footing:	$W_f := 30.5ft$
Length of Anchor Bolts:	$L_{st} := 48in$
Projection of anchor bolts above pier	$A_{BP} := 9.75 \cdot in$

PROPERTIES:

Compressive Strength of Concrete	$f'c := 3000psi$
Yield Strength of Steel Reinforcement	$fy := 60000 \cdot psi$
Yield Strength of Anchor Bolt	$fya := 75000 \cdot psi$
Internal Friction Angle of Soil	$\phi_s := 0 \cdot deg$
Allowable Bearing Capacity	$q_s := 6000 \cdot psf$
Unit Weight of Soil	$\gamma_s := 0 \cdot pcf$
Unit Weight of Concrete	$\gamma_c := 150 \cdot pcf$
Depth to Neglect	$n := 4.5ft$
Cohesion of Clay Type Soil Note: Use 0 for Sandy Soil	$c := 0 \cdot ksf$
Seismic Zone Factor: UBC Fig 23-2	$Z := 2$
Coefficient of Friction between Concrete:	$\mu := .20$
Clear Cover of Reinforcement Pier:	$Cvr_{pier} := 3 \cdot in$
Clear Cover of Reinforcement Pad:	$Cvr_{pad} := 3 \cdot in$
Anchor Bolt Diameter	$d_{anchor} := 2.25in$
Anchor bolt area	$A_{anchor} := 3.97 \cdot in^2$

PIER REINFORCEMENT:

Bar Size	$BSpier := 0$	Bar Diameter	$d_{bpier} := 0 \cdot in$
Number of Bars	$NBpier := 0$	Bar Area	$A_{bpier} := 0 \cdot in^2$

PAD REINFORCEMENT:

TOP:	Bar Size	$BS_{top} := 8$	Bar Diameter	$d_{btop} := 1.00 \cdot in$
	Number of Bars	$NB_{top} := 46$	Bar Area	$A_{btop} := 0.79 \cdot in^2$
BOTTOM:	Bar Size	$BS_{bot} := 8$	Bar Diameter	$d_{bbot} := 1.00 \cdot in$
	Number of Bars	$NB_{bot} := 46$	Bar Area	$A_{bot} := 0.79 \cdot in^2$

Coefficient of Lateral Soil Pressure: $K_p := \frac{1 + \sin(\phi_s)}{1 - \sin(\phi_s)}$ $K_p = 1$

Load Factor (EIA 3.1.1): $LF := if\left[H_t \le 700 \cdot ft, 1.3, if\left[H_t \ge 1200, 1.7, 1.3 + \left(\frac{H_t - 700}{1200 - 700}\right) \cdot 0.4\right]\right]$ $LF = 1.3$

URS

Job	180' Monopole - Norfolk, CT	Project No.	VZ5-167	Page	of
Description	Spread Footing w/ Pier Analysis	Computed by	CAR	Sheet 2	of 6
		Checked by		Date	10/15/13

CHECK ANCHOR STEEL EMBEDMENT

Depth:

$D_{ab} := L_{st} - A_{BP}$ $D_{ab} = 3.1875 \cdot ft$ $L_{anchor} := \frac{(0.11 \cdot fy) \cdot in}{\sqrt{f'c \cdot psi}}$ $L_{anchor} = 10.0416 \cdot ft$

$DepthCheck := if(D_{ab} \geq L_{anchor}, "Okay", "No Good")$

$DepthCheck = "No Good"$ **Note:** anchor plate is provided

STABILITY OF FOOTING

Passive Pressure:

$P_{pn} := K_p \cdot \gamma_s \cdot n + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pn} = 0 \cdot ksf$

$P_{pt} := K_p \cdot \gamma_s \cdot (D_f - T_f) + c \cdot 2 \cdot \sqrt{K_p}$ $P_{pt} = 0 \cdot ksf$

$P_{top} := if[n < (D_f - T_f), P_{pt}, P_{pn}]$ $P_{top} = 0 \cdot ksf$

$P_{bot} := K_p \cdot \gamma_s \cdot D_f + c \cdot 2 \cdot \sqrt{K_p}$ $P_{bot} = 0 \cdot ksf$

$P_{ave} := \frac{P_{top} + P_{bot}}{2}$ $P_{ave} = 0 \cdot ksf$

$T_p := if[n < (D_f - T_f), T_f, (D_f - n)]$ $T_p = 0 \cdot ft$

$A_p := W_f \cdot T_p$ $A_p = 0 \cdot ft^2$

Ultimate Shear:

$S_u := P_{ave} \cdot A_p$ $S_u = 0 \cdot kip$

Weight of Concrete Pad:

$WT_c := \left[\left(W_f^2 \cdot T_f\right) + d_p^2 L_p\right] \cdot \gamma_c$ $WT_c = 627.9187 \cdot kip$

Weight of Soil: above Footing:

$WT_{s1} := \left[W_f^2 \cdot \left(\left|L_p - L_{pag}\right|\right) - \frac{d_p^2 \cdot \pi}{4} \cdot \left(\left|L_p - L_{pag}\right|\right)\right] \cdot \gamma_s$ $WT_{s1} = 0 \cdot kip$

Weight of Soil Wedge at back face:

$WT_{s2} := \left(\frac{D_f \cdot \tan(\phi_s)}{2} \cdot W_f\right) \cdot \gamma_s$ $WT_{s2} = 0 \cdot kip$

Total Weight:

$WT_{tot} := WT_c + WT_{s1} + C_t$ $WT_{tot} = 669.1187 \cdot kip$

Resisting Moment:

$M_r := (WT_{tot}) \cdot \frac{W_f}{2} + S_u \cdot \frac{T_f}{3} + WT_{s2} \cdot \left(W_f + \frac{D_f \cdot \tan(\phi_s)}{3}\right)$ $M_r = 10204.0609 \cdot kip \cdot ft$

Overturning Moment:

$M_{ot} := M_t + S_t \cdot (L_p + T_f)$ $M_{ot} = 2868.15 \cdot kip \cdot ft$

Factor of Safety:

$FS := \frac{M_r}{M_{ot}}$ $FS_{req} := 2$ $FS = 3.56$

$SafetyCheck := if(FS > FS_{req}, "Okay", "No Good")$ $SafetyCheck = "Okay"$

SHEAR CAPACITY IN PIER

$FS := 2$

$$S_p := \frac{P_{ave} \cdot A_p + \mu \cdot WT_{tot}}{FS}$$

$S_p = 66.9119 \cdot kips$

$ShearCheck := if(S_p > S_t, "Okay", "No Good")$

$ShearCheck = "Okay"$

BEARING PRESSURE CAUSED BY FOOTING

$A_{mat} := W_f^2$ $\quad A_{mat} = 930.25 \cdot ft^2$

$S := \frac{W_f^3}{6}$ $\quad S = 4728.7708 \cdot ft^3$

$P_{max} := \frac{WT_{tot}}{A_{mat}} + \frac{M_{ot}}{S}$ $\quad P_{max} = 1.3258 \cdot ksf$

$P_{min} := \frac{WT_{tot}}{A_{mat}} - \frac{M_{ot}}{S}$ $\quad P_{min} = 0.1128 \cdot ksf$

$MaxPressure := if(P_{max} < q_s, "Okay", "No Good")$ $\quad MaxPressure = "Okay"$

$MinPressure := if[(P_{min} \geq 0) \cdot (P_{min} < q_s), "Okay", "No Good"]$ $\quad MinPressure = "Okay"$

Distance to Resultant of Pressure Distribution:

$$X_p := \frac{P_{max}}{\frac{P_{max} - P_{min}}{W_f}} \cdot \frac{1}{3}$$

$X_p = 11.1117 \cdot ft$

Distance to Kern:

$$X_k := \frac{W_f}{6}$$

$X_k = 5.0833 \cdot ft$

Since Resultant Force is Not in Kern, Area to which Pressure is Applied Must be Reduced.

Eccentricity:

$$e := \frac{M_{ot}}{WT_{tot}}$$

$e = 4.2865$

Adjusted Soil Pressure:

$$P_a := \frac{2 \cdot WT_{tot}}{3 \cdot W_f \cdot \left(\frac{W_f}{2} - e\right)}$$

$P_a = 1.334 \cdot ksf$

$$q_{adj} := if\left(P_{min} < 0, P_a, \frac{P_{max}}{ft^2}\right)$$

$q_{adj} = 1.3258 \cdot ksf$

$PressureCheck := if(q_{adj} < q_s, "Okay", "No Good")$ $\quad PressureCheck = "Okay"$

CONCRETE BEARING CAPACITY (ACI 10.17)

$\phi_c := 0.75$ (ACI 9.3.2.2)

$P_b := \phi_c \cdot 0.85 \cdot f'c \cdot \frac{d_p^2 \cdot \pi}{4}$ $P_b = 0 \cdot kip$

$BearingCheck := if(P_b > LF \cdot C_t, "Okay", "No Good")$ BearingCheck = "No Good"

Note: Above result not applicable due to absence of pier.

SHEAR STRENGTH OF CONCRETE

Beam Shear: (Critical section located at a distance d from the face of Pier) (ACI 11.3.1.1)

$\phi_{vc} := .85$ (ACI 9.3.2.3)

$d := T_f - Cvr_{pad} - d_{bbot}$ $d = 50 \cdot in$

$d_1 := \frac{W_f}{2} - \frac{d_p}{2}$ $d_1 = 15.25 \cdot ft$

$d_2 := d_1 - d$ $d_2 = 11.0833 \cdot ft$

$L := \left(\frac{W_f}{2} - e\right) \cdot 3$ $L = 32.8906 \cdot ft$

$Slope := if\left(L > W_f, \frac{P_{max} - P_{min}}{W_f}, \frac{q_{adj}}{L}\right)$ $Slope = 0.0398 \cdot kcf$

$V_{req} := LF \cdot \left[\left(q_{adj} - Slope \cdot d_1\right) + \left(\frac{Slope \cdot d_1}{2}\right)\right] \cdot W_f \cdot d_1$ $V_{req} = 618.3007 \cdot kip$

ACI 11.3.1.1 $V_{Avail} := \phi_c \cdot 2 \cdot \sqrt{f'c \cdot psi} \cdot W_f \cdot d$ $V_{Avail} = 1703.9649 \cdot kip$

$BeamShearCheck := if(V_{req} < V_{Avail}, "Okay", "No Good")$ BeamShearCheck = "Okay"

Punching Shear: (Critical Section Located at a distance of d/2 from the face of pier) (ACI 11.12.2.1)

$b_o := (d_p + d) \cdot \pi$ $b_o = 13.09 \cdot ft$

Area included inside bo: $A_{bo} := \frac{\pi \cdot (d_p + d)^2}{4}$ $A_{bo} = 13.6354 \cdot ft^2$

Area outside of bo: $A_{out} := A_{mat} - A_{bo}$ $A_{out} = 916.6146 \cdot ft^2$

Guess Value: $v_u := 1ksf$

(From "Foundation Analysis and design", By Joseph Bowles, Eq. 8-9)

Given $d^2 + d_p \cdot d = \frac{WT_{tot}}{\pi \cdot v_u}$

$v_u := \text{Find}(v_u)$ $v_u = 12.2681 \cdot ksf$

$V_u := v_u \cdot d \cdot W_f$ $V_u = 1559.0657 \cdot kips$

$V_{req} := LF \cdot V_u$ $V_{req} = 2026.7854 \cdot kips$

$V_{Avail} := \phi_c \cdot 4 \cdot \sqrt{f'c \cdot psi} \cdot b_o \cdot d$ $V_{Avail} = 1462.613 \cdot kips$

$PunchingShearCheck := \text{if}(V_{req} < V_{Avail}, \text{"Okay"}, \text{"No Good"})$ PunchingShearCheck = "No Good"

Note: Above result not applicable due to absence of pier.

STEEL REINFORCEMENT IN THE PAD $\phi_m := .90$ ACI 9.3.2.2

Take Maximum Bending at face of Pier:

$q_b := q_{adj} - d_1 \cdot Slope$ $q_b = 0.7193 \cdot ksf$

$M_n := \frac{LF}{\phi_m} \cdot \left[(q_{adj} - q_b) \cdot \frac{d_1^2}{3} + q_b \cdot \frac{d_1^2}{2} \right] \cdot W_f$ $M_n = 5756.2414 \cdot kip \cdot ft$

ACI 10.2.7.3 $\beta := \text{if}\left[f'c \le 4000 \cdot psi, .85, \text{if}\left[f'c \ge 8000 \cdot psi, .65, .85 - \left(\frac{\frac{f'c}{psi} - 4000}{1000} \right) \cdot .05 \right] \right]$ $\beta = 0.85$

$R_u := \frac{M_n}{\phi_m \cdot W_f \cdot d^2}$ $R_u = 12078.7\ lbf$

$\rho := \frac{0.85 \cdot f'c}{fy} \left(1 - \sqrt{1 - \frac{2 \cdot R_u}{0.85 \cdot f'c}} \right)$ $\rho = 0.0014$

$\rho_{min} := 1.0 \cdot \rho$ $\rho_{min} = 0.0014$

URS

Job	180' Monopole - Norfolk, CT	Project No.	VZ5-167	Page / Sheet	of 6
Description	Spread Footing w/ Pier Analysis	Computed by	CAR	Date	10/15/13
		Checked by		Date	

Temperature and Shrinkage: $\rho_{sh} := if(fy \geq 60000 \cdot psi, 0.0018, 0.0020)$ $\rho_{sh} = 0.0018$

(ACI 7.12.2.1b)

FOR BOTTOM BARS: $As := \max(\rho, \rho_{min}, \rho_{sh}) \cdot W_f \cdot d$ $As = 32.94 \cdot in^2$

$As_{prov} := A_{bot} \cdot NB_{bot}$ $As_{prov} = 36.34 \cdot in^2$

$PadReinforcement := if(As_{prov} > As, "Okay", "No Good")$ $PadReinforcement = "Okay"$

FOR TOP BARS: $As := \rho_{sh} \cdot (W_f \cdot d)$ $As = 32.94 \cdot in^2$

$As_{prov} := A_{btop} \cdot NB_{top}$ $As_{prov} = 36.34 \cdot in^2$

$PadReinforcement := if(As_{prov} > As, "Okay", "No Good")$ $PadReinforcement = "Okay"$

TENSION (ACI 12.2.3) **DEVELOPMENT LENGTH OF PAD REINFORCEMENT**

Bar Spacing: $B_{sPad} := \frac{W_f - 2 \cdot Cvr_{pad} - NB_{bot} \cdot d_{bbot}}{NB_{bot} - 1}$ $B_{sPad} = 6.9778 \cdot in$

Development Length Factors:

Reinforcement Location Factor	$\alpha := 1.0$
Coating Factor	$\beta := 1.0$
Concrete strength Factor	$\lambda := 1.0$
Reinforcement Size Factor	$\gamma := 1.0$

Spacing or Cover Dimension: $c := if\left(Cvr_{pad} < \frac{B_{sPad}}{2}, Cvr_{pad}, \frac{B_{sPad}}{2}\right)$ $c = 3 \cdot in$

Transverse Reinforcement Index: As allowed by ACI 12.2.4 $k_{tr} := 0$

$$L_{dbt} := \frac{3}{40} \cdot \frac{fy}{\sqrt{f'c \cdot psi}} \cdot \frac{\alpha \cdot \beta \cdot \gamma \cdot \lambda}{\frac{c + k_{tr}}{d_{bbot}}} \cdot d_{bbot}$$ $L_{dbt} = 27.3861 \cdot in$

$L_{dbmin} := 12 \cdot in$

Minimum Development Length: (ACI 12.2.1) $L_{dbtCheck} := if(L_{dbt} \geq L_{dbmin}, "Use L.dbt", "Use L.dbmin")$ $L_{dbtCheck} = "Use L.dbt"$

Available Length in Pad: $L_{Pad} := \frac{W_f}{2} - \frac{d_p}{2} - Cvr_{pad}$ $L_{Pad} = 180 \cdot in$

$LpadTension := if(L_{Pad} > L_{dbt}, "Okay", "No Good")$ $LpadTension = "Okay"$